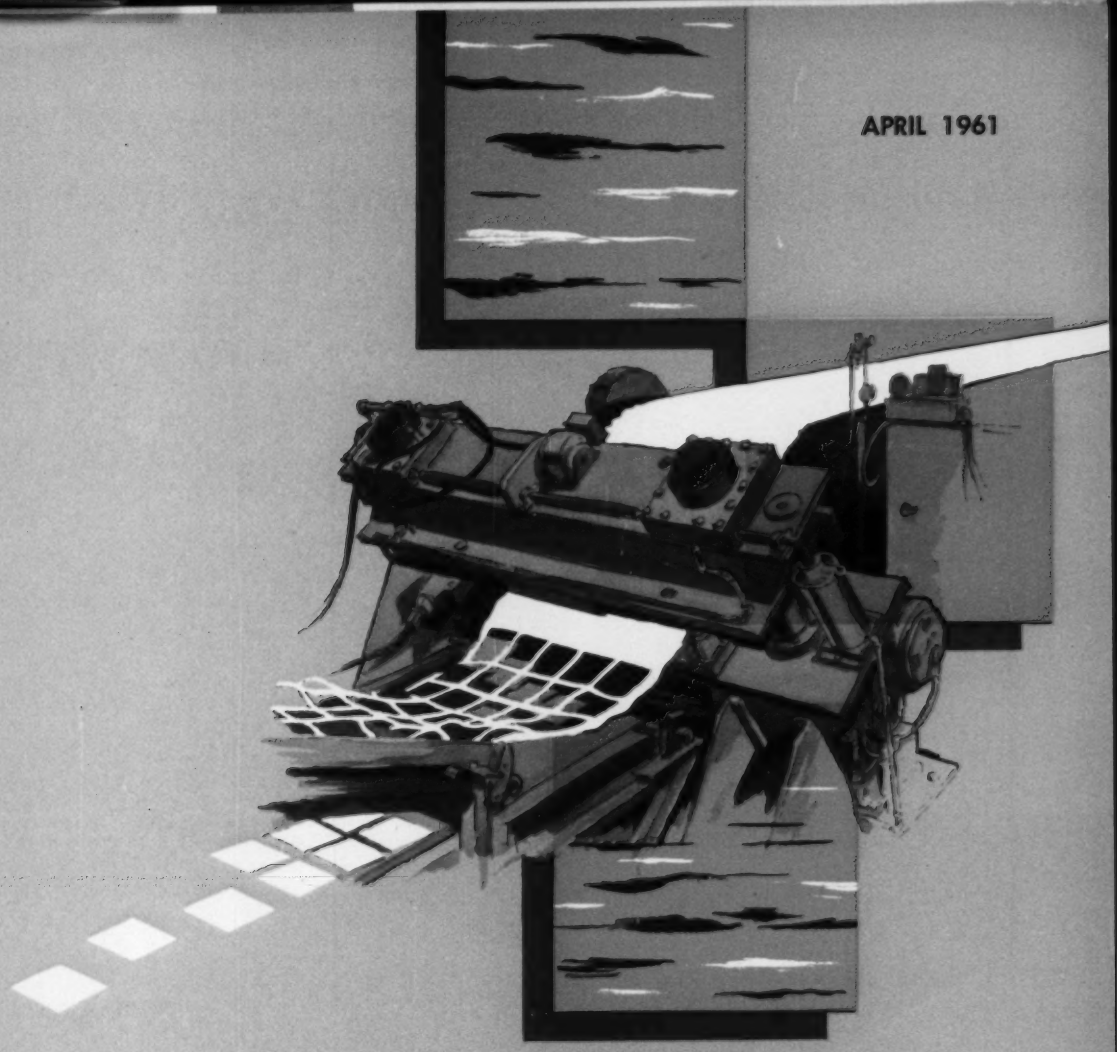
AUTOMATION

APRIL 1961



Making Floor Tiles

THE MAGAZINE OF AUTOMATIC MANUFACTURING OPERATIONS

- **Legal Implications of Computer Use**
- **Conveyor Dispatching System**
- **Elements of Positioning Controls**
- **Answers to Numerical Control**

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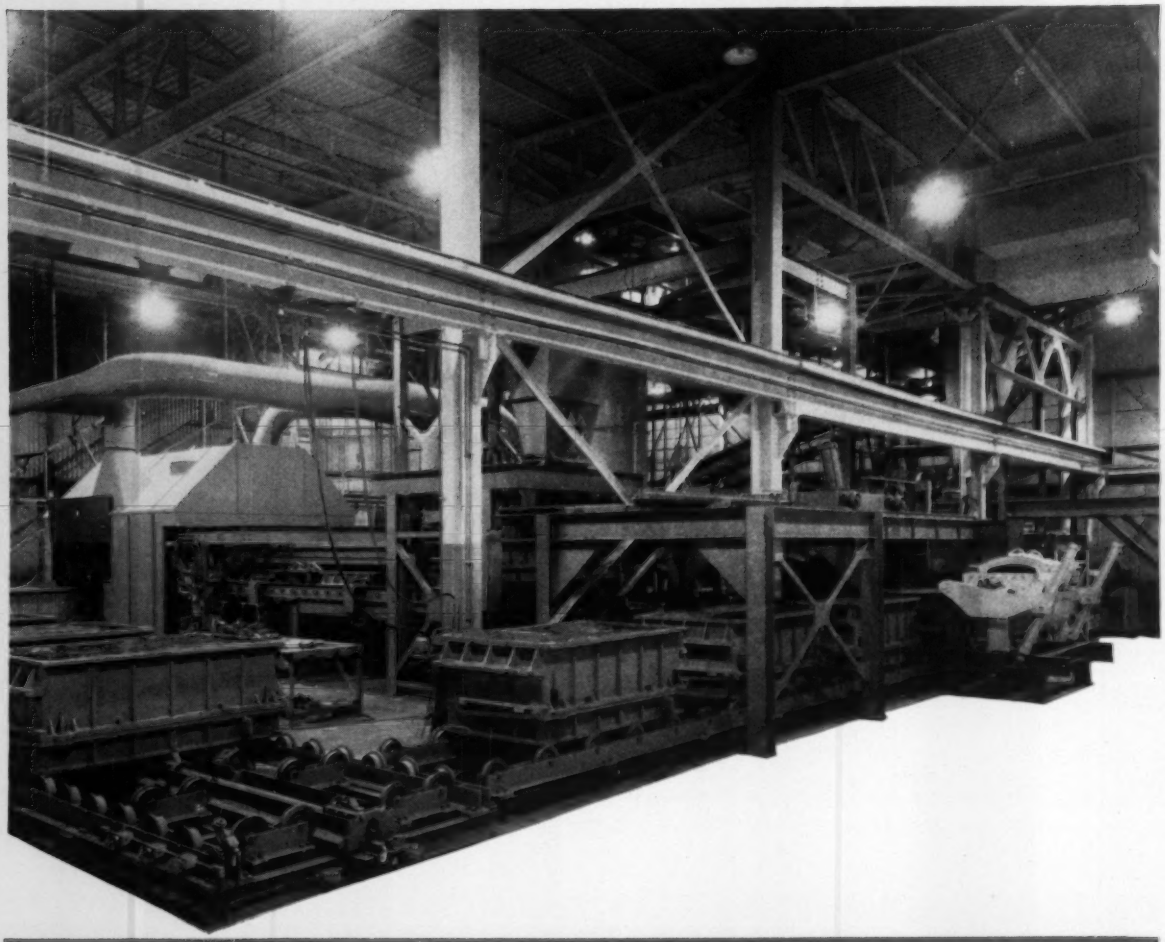
A PENTON PUBLICATION



another example of Planet Versatility...

NEW AUTOMATIC MOLD HANDLING SYSTEM

PRODUCES SEVENTY-TWO 14,000-LB. MOLDS PER HOUR

This new automatic bathtub mold handling system is one of the largest and most advanced systems in existence. The system has a capacity to turn out seventy-two 14,000-pound molds (includes flasks, sand and casting) per hour and requires only seven operators.

Engineered and fabricated by Planet Corporation and installed in Universal/Rundle Corporation's Camden, New Jersey, foundry, this new automatic bathtub mold handling system has achieved several "firsts." They are:

- First to be completely shuttle-indexed.
- First to use weights rather than clamps.
- First to incorporate automatic sand metering.
- First to index flasks through shakeout.

Custom designed systems such as this have helped build Planet Corporation's reputation throughout industry as a versatile organization . . . as an organization with solutions to the most perplexing materials handling and automation problems. Let Planet demonstrate how "PV" —Planet Versatility—can help you solve your problems . . . you'll find it pays to plan with Planet.

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- Engineered Handling Systems
- Automation Equipment
- Mill & Foundry Equipment

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Circle 651 on Page 35

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Hanna Cylinders and Valves furnish economical power for thousands of jobs. Not only are they economically priced, but the long life built into these products means that you will continue to operate at minimum cost.

The service offered by Hanna and its more than 60 sales representatives in the United States, Canada, and Foreign Countries can't be beat. Hanna Cylinders and Valves stocked at the Hanna factory and at many representatives' offices help solve your "needed now" problems. Because of efficient Hanna production, "built to order" cylinders take only a few days.

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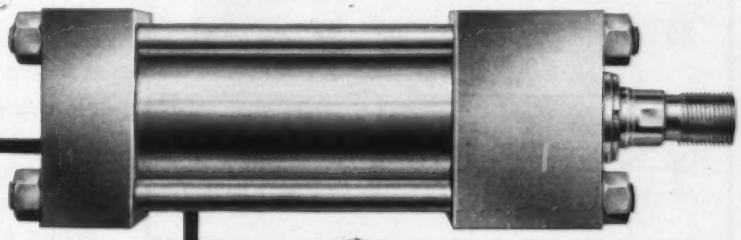

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2000 and 3000 psi non shock. 1½" through 8" bores.

FEATURING—Pressure Tightening Tube Seals • One Piece Steel Heads with Welded Mountings • Dual Seal Piston Rings • Fast Change Cartridge Gland • Lubricated Bearing

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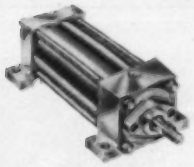

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1½" through 14" bore sizes in a variety of mounting styles and rod sizes. The latest in cylinder design with standard mounting dimensions. Air to 250 psi, Hydraulic to 1000 psi. Ask for Catalog 801.

HANNA T750 SERIES FLUID POWER CYLINDERS

Air to 250 psi, Hydraulic to 750 psi. 1½" through 4" bores. Ask for Catalog 750.

and operated Unitite valves. Bulletin 277.

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Foot Operated Valves. Bulletin 278.

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HYDRAULIC & PNEUMATIC EQUIPMENT • CYLINDERS • VALVES

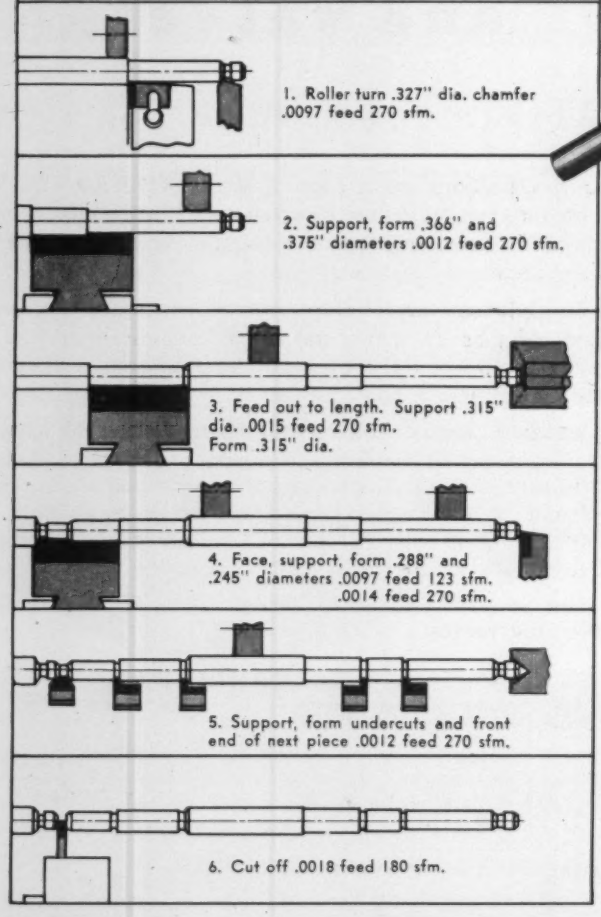
ELSTON AVENUE CHICAGO 22, ILLINOIS

Circle 654 on Page 35

GREENLEE AIR-FEED AUTOMATICS BENEFIT "ELECTROLUX" FOUR WAYS . . .

MACHINE . . . 1"-6 Automatic Bar Machine Air-Feed — Feedout on index and in 3rd position during machine cycle.
TOOLING . . . Carbide Tipped
MATERIAL . . . 1137
STOCK SIZE . . . 13/32" rd.

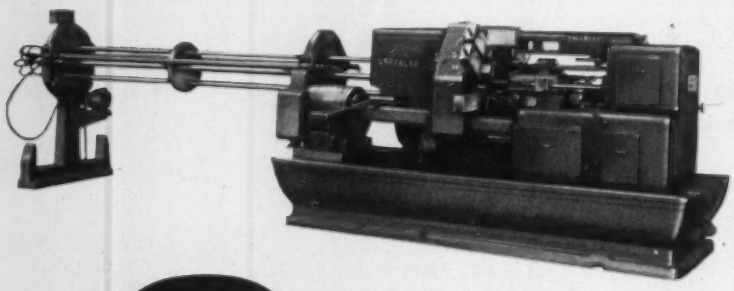
TOOL SLIDE STROKE . . 1-9/16" at .0097" feed.
SPINDLE SPEED . . . 2540 rpm 270 sfm.
MACHINE TIME . . . 5.8 seconds.
ESTIMATED GROSS PRODUCTION . . . 620 per hour


1. Roller turn .327" dia. chamfer .0097 feed 270 sfm.
2. Support, form .366" and .375" diameters .0012 feed 270 sfm.
3. Feed out to length. Support .315" dia. .0015 feed 270 sfm. Form .315" dia.
4. Face, support, form .288" and .245" diameters .0097 feed 123 sfm. .0014 feed 270 sfm.
5. Support, form undercuts and front end of next piece .0012 feed 270 sfm.
6. Cut off .0018 feed 180 sfm.

1. Eliminate stock pushers . . .
2. Eliminate scoring of stock . . .
3. Reduce downtime during set-up . . .
4. Provide extra length feed-out . . .

The part is a 6-7/8" long armature shaft used in the "Electrolux" vacuum cleaner. It demonstrates how effectively Greenlee Air-Feed Automatics and carbide tooling can team-up to increase production and reduce costs. The shaft is machined from 13/32" S.A.E. 1137 steel at a gross production rate of 620 pieces per hour. Recommended cutting speed for high speed tooling is 120 sfm. The rate was boosted to 270 sfm with carbide-tipped tooling. Sequence of operations is shown at the left.

Note how the stock is partially fed out on the index and to its full length in the third position. This provides for the most effective tooling arrangement. Greenlee Air-Feed Automatics permit greater job versatility and assure added profits. See your Greenlee representative or send us a print of your high-cost problem-part.



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The Magazine of Automatic Manufacturing Operations

AUTOMATION

A PENTON PUBLICATION

APRIL 1961
Vol. 8 — No. 4

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automation outlook

SURE CURE

MUCH ADO is being made in Government circles concerning unemployment and the possibility that automation could be a contributing factor. Eventually we must all face the fact that automation, like any economizing measure, is another means for keeping manufacturing costs in line. Every business must take in more money than it spends or it is finis.

The problem could be likened to the gas turbine cycle. Unless there is more horsepower developed at the power turbine wheel than is consumed by the compressor section, there is no usable output at the shaft. Such a design is a failure and the designer is a "flop." It is no different with a business. As the overhead costs of carrying on the business rise, efficiency over-all must increase to maintain the same income to expense ratio in the face of competitive pressure on prices. Even though many highly successful businesses require expenditures almost as high as income, there is a margin, and this is what counts.

Continually increasing taxes and wages create a heavy pressure to raise efficiency, and automation has become a must as a result. While making ominous sounds in the direction of automation activity in business, the Kennedy administration is creating a mammoth paradox by simultaneously advancing vast programs that will increase taxes and wages still more. As taxes and wages consume an increasing portion of manufacturing overhead, operating costs must be reduced or prices inflated. Strong competition today dictates the former, and an imperative advance into more automation.

There is no question that automation technology will eventually make possible the support of an advanced standard of living for everyone, but to avoid damaging upheavals there must be time to permit a gradual evolution.

It is unrealistic to harbor the idea that financial assistance in depressed areas and unemployment benefits alone will solve the complex problem of full employment in the years to come. There is need to revive the Frontier spirit of early America among working people—the inquisitive, practical, restless, energetic, and inventive pioneering spirit. Opportunities are great and are increasing but seldom are they presented on a silver platter.

It is imperative that the American workman adjust to mobility, that he be inspired to initiative, and that he adapt and grow with technological change. He must become a vital and knowledgeable part of the industrial scene, not a bystander. No matter how attached the workman of old was to his job of trimming wicks, he himself helped mightily in ringing down the curtain on oil lamps. So it is today in the same degree. The standard of living is raised through technological advance—we cannot expect to enjoy its blessings and yet condemn it.

Let's hope we can approach these evolutionary industrial problems on a sound and rational basis. Surely in the face of evidently conflicting activities, it behooves every lawmaker to take a careful second look before any unnecessary additional problems are created.

Programs that result in higher taxes and wages may be like the sure cure for a transitory illness—operation successful but the patient died.

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BPA NBP

Fluid Power NEWS

OILGEAR 40 Years of Fluid Power

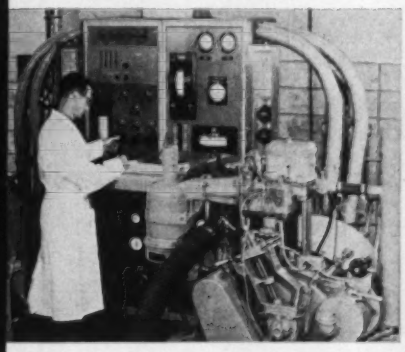
Report No. 12,400 From Oilgear *Application-Engineering* Files

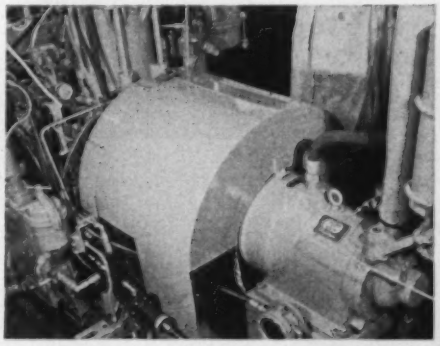
HOW OILGEAR-ESSO RESEARCH TEAMWORK SOLVED NEED FOR MORE COMPACT, LOWER COST, RELIABLE, HIGHLY ACCURATE, DYNAMOMETER AND STARTER SYSTEMS

USER: *Esso Research and Engineering Corp., Linden, New Jersey*

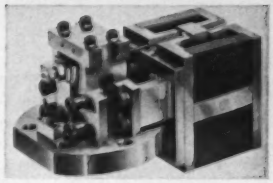
PROBLEM: New Equipment to conduct the exhaustive, standardized performance tests on all new fuels and lubricants, as required by the oil companies and engine manufacturers — to guarantee top-quality petroleum products for optimum consumer engine performance. These extended tests — carefully recorded and regulated from operating control centers — are performed with *standard test* engines coupled to load-absorbing dynamometers. Cradled, expensive electrical load absorbers were previously used to provide test engine control.

ESSO RESEARCH REQUIREMENTS FOR A NEW DYNAMOMETER SYSTEM WERE: 1. Sharply reduce installed cost and valuable test floor space. 2. Insure absolutely reliable, precise, loading and speed control over continuous periods up to 1,000 hours per test. 3. Simplify test engine starting methods — normally 50-hp motors are used to overcome high starting torques, due to heavy flywheels and high internal friction. 4. Long life, maximum trouble-, and maintenance-free durability.

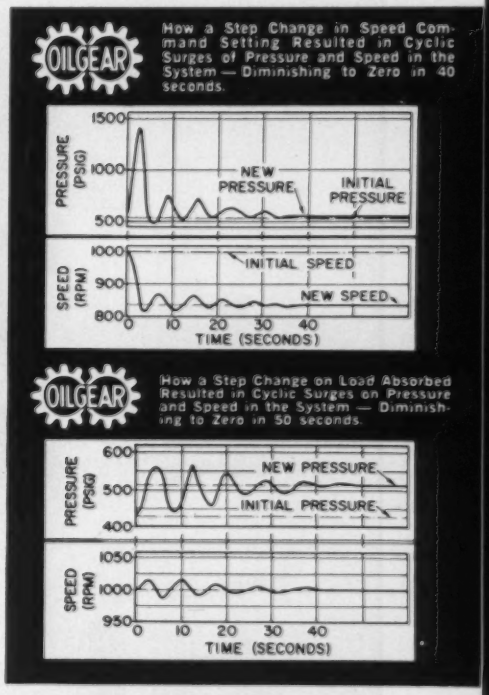




LEFT: One of the Oilgear-Esso Research centralized control centers for complete recording, regulation, control, and operation of two test engines, and the Oilgear servo-valve-controlled Dynamometer and Starters connected to them. **RIGHT:** Rear view of 5¾" bore by 8" stroke, Standard Single Cylinder Test Engine with Oilgear servo-valve-controlled Dynamometer/Starter. This efficient, compact, Oilgear pump/motor unit is shaft-coupled to the test engine . . . cranks the engine for starting — then absorbs all power produced during testing. Other system equipment — Oilgear servo-valve "Power Paks" that regulate the loads imposed on the test engines and Oilgear remote, air-controlled Type "DA" Variable Displacement Pump used for starting the test engines — are mounted on the floor above to free valuable test floor area for additional testing units.



SERVOCONTROL* — Single-Stage, Four-Way Servo Valve without enclosure . . . exclusive "Swing-Plate" design . . . only one moving part . . . no metal-to-metal contact . . . as used with this installation.
A Division of The Oilgear Company



SOLUTION: A completely new servo-valve-controlled *Dynamometer and Starting System* was *Application-Engineered* by Oilgear's Servocontrol Division. In addition to meeting all engine control and starting requirements, these new systems were installed *at 50% of the cost of comparable "universal" electric dynamometer systems.* Addition of two more test units to this system will result in a saving of 65% for the four-ganged arrangement. The unusual, centralized starting system has adequate capacity to start a large number of test engines — one at a time — and maintain the required supercharge on the dynamometer pump/motors during test-loading. Oilgear loading Pump/Motors permit more compact installations than equivalent capacity alternate systems. Simple safety interlocks protect the equipment, and guarantee positive, correct operating sequence of all starting and loading test procedures.

ESSO RESEARCH REPORTS — *"Other than installed cost and space saving, the prime requirement of this dynamometer was to maintain a constant speed for variations in temperature, engine torque, etc. This system maintains an accuracy of 1 rpm at an engine speed of 1000 rpm — or a speed accuracy of 0.1%.*

Information contained in this Fluid Power News Report is condensed from a paper entitled, "Electro-Hydraulic Dynamometer and Starter for Laboratory Test Engine" — by J. W. Broome, Chief Engineer, Servocontrol Division of The Oilgear Company, and R. L. Van Voorhies, Senior Engineer, Mechanical Division, Esso Research and Engineering Company . . . presented at the NCIH — Chicago, Illinois. OILGEAR — SERVOCONTROL are trademarks of The Oilgear Company.

By sizing the hydraulic equipment to torque and speed required, these same fundamental components can be applied to other dynamometer applications . . . and for controlling other variables. OILGEAR-SERVOCONTROL can supply *everything* a carefully engineered system requires . . . reduce delays, costly machine downtime due to malfunctioning, and actually save you money on engineering, components wiring, piping, installation and testing costs — PLUS the assurance that only a "single-source, single-responsibility" can give.

For practical, lowest-cost-per-year solutions to YOUR rotary or linear drive and control problems, call the factory-trained Oilgear Application-Engineer in your vicinity. Or write, stating your specific requirements, directly to . . .

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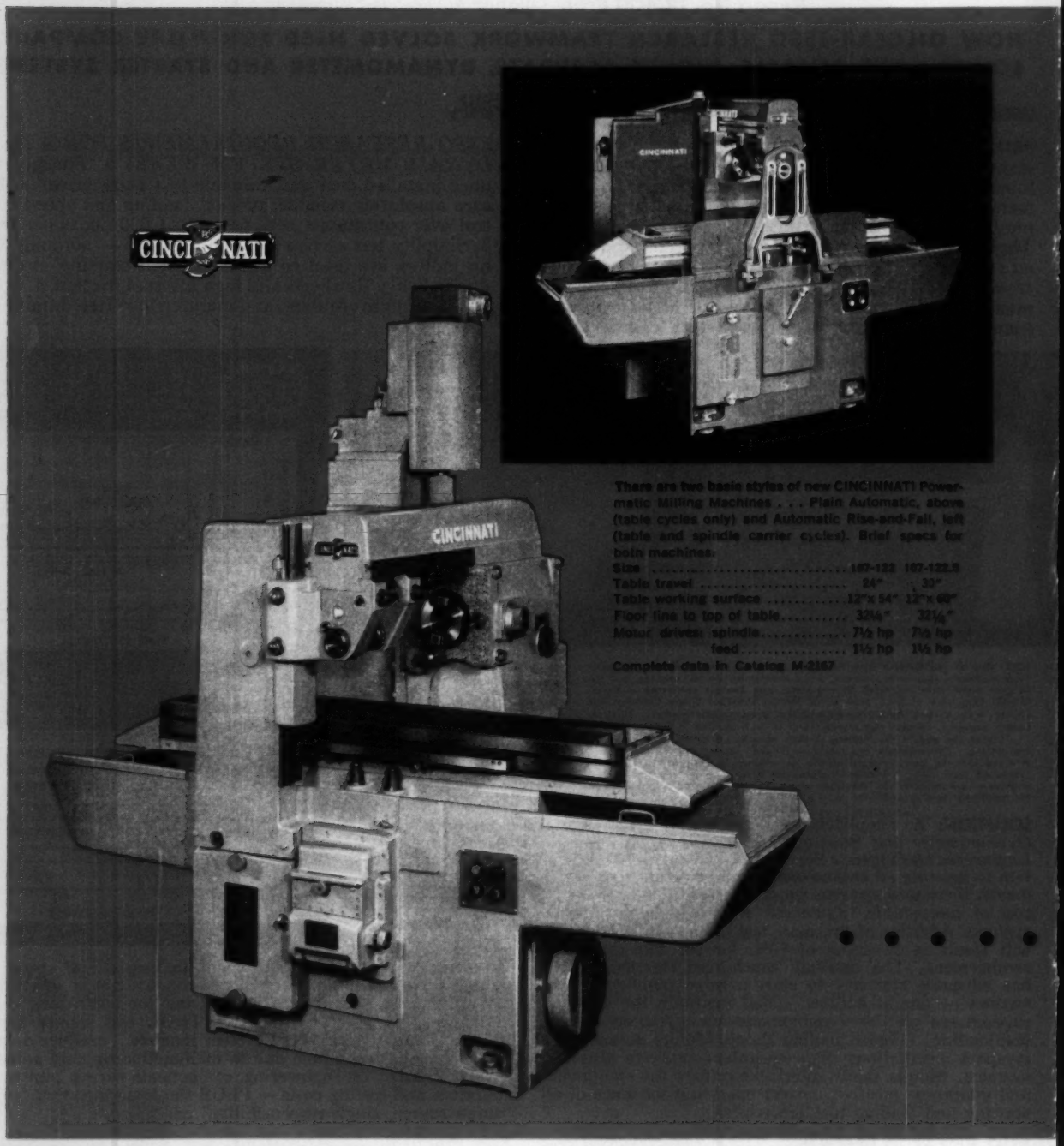


There are two basic styles of new CINCINNATI Powermatic Milling Machines . . . Plain Automatic, above (table cycles only) and Automatic Rise-and-Fall, left (table and spindle carrier cycles). Brief specs for both machines:

Size	107-122	107-122-S
Table travel	24"	30"
Table working surface	12"x 54"	12"x 60"
Floor line to top of table	32¾"	32¼"
Motor drives: spindle	7½ hp	7½ hp
feed	1½ hp	1½ hp

Complete data in Catalog M-2157

KNEE TYPE AND BED TYPE MILLING MACHINES • DIE SINKING MACHINES • CUTTER AND TOOL GRINDERS •

THE CINCINNATI MILLING MACHINE CO., CINCINNATI 9, OHIO

Powermatic

MILLING MACHINE

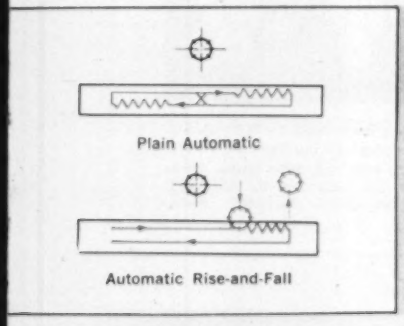
. . . . *for intermediate range automatic milling*

The newest Cincinnati bed type . . . the Powermatic . . . fills the need for a fast, automatic medium-duty milling machine. The Powermatic is built in two styles: Plain Automatic (automatic cycles for the table only) and Automatic Rise-and-Fall (automatic cycles for the table and spindle carrier). In addition to the usual types of operations, the Automatic Rise-and-Fall style may be equipped to perform: (1) contour milling within 30° rise from the horizontal, and (2) box milling, or jobs which require feeding up.

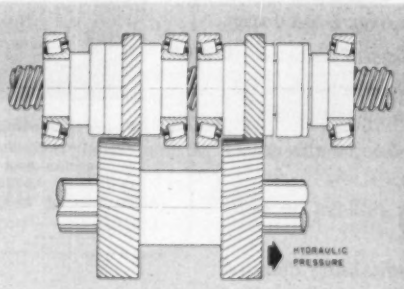
Here are some of the ways in which these new automatic machines measure up to the highest standards of performance:

- *Automatic two-way table cycles* . . . a production advantage for reciprocal milling setups.
- *Automatic backlash eliminator* . . . a necessary feature for "down" or "climb" milling and reciprocal setups.
- *One integral casting for the front base and column* . . . assures maximum rigidity for full hp cuts.
- *Table feeds and spindle speeds easily changed* . . . simple pick-off gears; no wrenches required.
- *Single lever control* . . . starts the complete automatic cycle.
- *Effective chip and cutting fluid collecting system* . . . chip pans easily removed when full.
- *Dynapoise overarm* . . . damps chatter, thereby allowing highest feed rates to be used.
- *Automatic Rise-and-Fall style* . . . spindle carrier feeds down 1 to 40 ipm; rapid up and down; vertical cycles synchronized with table cycles; cycle selectors, readily interchanged, control sequence of events.

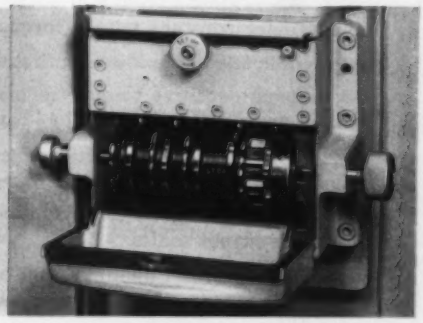
Get more information by asking for a copy of Catalog M-2167. **Milling Machine Division, The Cincinnati Milling Machine Co.**, *Telephone RE 1-2121.*



Fast automatic cycles give the Powermatic extra high potential for reducing costs . . . 300 ipm table rapid traverse reduces "cutting air" to a minimum.



Automatic compensation . . . for wear between table feed screw and nut; a prime feature-advantage for reciprocal setups and "down" milling.



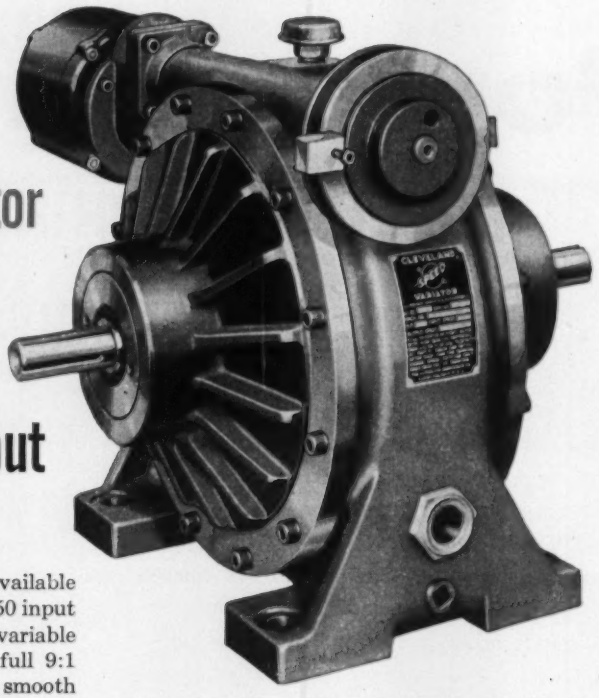
Program director . . . the cycle selector is a simple camshaft unit. It controls sequence of events in automatic cycle. Can be interchanged in a minute or less.

VERTICAL BROACHING MACHINES • ELECTRICAL MACHINING EQUIPMENT

CINCINNATI®
MILLING MACHINE DIVISION

Circle 656 on Page 35

Cleveland Speed Variator is the Best Answer to *Precision Control* of Variable Speed Output



Advanced-designed Cleveland Speed Variators—available in 18 models ranging from fractional to 16 hp at 1750 input RPM—accurately provides dependable, infinitely variable speed control. They give stepless speed over a full 9:1 range—from ⅓ to 3 times input speed. Instant smooth change of output speed can be adjusted by either manual, automatic or remote control. Precise adjustments are always made with accurate adherence to settings.

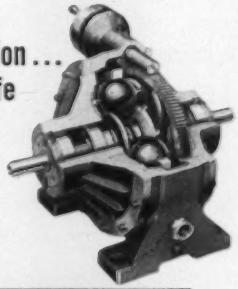
Thousands of Variators are in daily use on such varied industrial equipment as cigarette-making machines, textile machinery, metalworking machinery, pharmaceutical equipment, transfer tables, conveyors and experimental and testing equipment of many types.

Check these major Variator advantages:

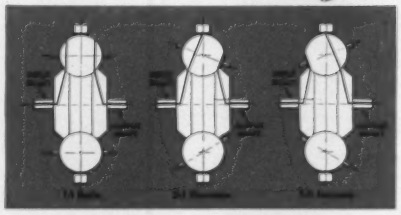
- An extremely compact unit with input and output shafts in line and rotating in the same direction
- Almost any input speed up to 1800 RPM can be used —either clockwise or counterclockwise rotation
- Rated for constant horsepower output over a 9:1 or 6:1 range; or for constant output torque over a 6:1 range
- Speeds infinitely variable over entire range of adjustment
- No slippage—positive torque response mechanism adjusts in direct proportion to the loads encountered
- Long life and minimum maintenance due to absence of belts or complicated linkages
- Ample bearing support for overhung pulleys on both input and output shafts

Write today for free Bulletin K-200 containing detailed description, photographs, sectional drawings, rating tables and specifications.

Simple in Operation... Built for Long Life



The Variator is an extremely compact unit with input and output shafts in line, rotating in the same direction. It incorporates ample bearing support to carry overhung pulleys.



Power is transmitted from input shaft to output shaft through alloy steel driving balls which are in pressure contact with the drive discs. Relative shaft speeds are adjusted by changing position of axles on which the balls rotate.

Cleveland Worm & Gear Division
Eaton Manufacturing Company
3265 East 80th Street • Cleveland 4, Ohio

EATON®

CLEVELAND SPEED VARIATOR

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AUTOMATION news

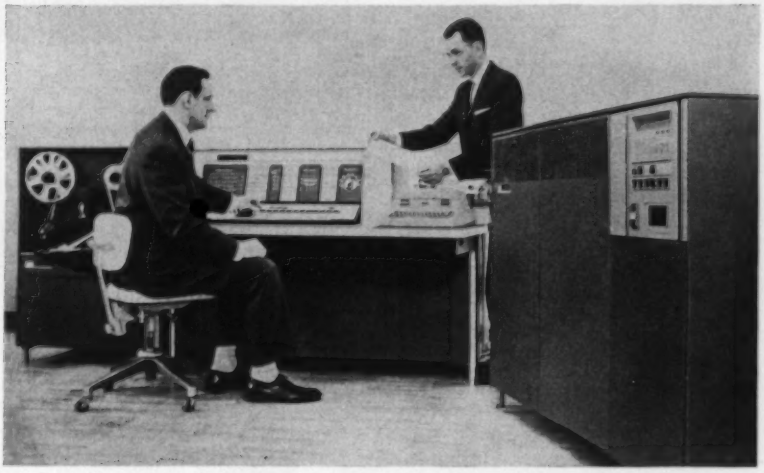
Today's events and developments in the field of automation

IBM Enters Industrial Control Field

MULTIPURPOSE industrial control system designed by International Business Machines Corp. for a variety of uses in process study, process optimization, and manufacturing quality control marks the company's entry into the control area. The 1710 system consists of a 1711 data converter connected to a solid-state 1620 computer. The converter scans up to 300 control instruments at the rate of five a second and converts the analog signals to digital form. These signals are fed directly to the computer without the need for off-line conversion equipment.

In process study, the system can perform various mathematical analyses such as correlation and regression studies to build a mathematical model as a step toward computer-directed process control.

In process optimization, the system improves process performance by furnishing guides to the operator as a result of the calculations performed on sampled data. It automatically accepts analog signals representing measurements of variables such as feed composition, temperatures, pressures, flow rates, product qualities, loads, and other information needed to determine the optimum conditions of operation. It repeatedly analyzes the information in terms of the mathematical model used to describe the process and advises the plant operator by paper tape, card, or typewritten output.



DATA CONVERTER (right) automatically scans as many as 300 instruments connected to an industrial process or operation and feeds the information in digital form to the solid-state computing unit (center) for evaluation. Instructions for adjusting control settings or information indicating flaws in manufacturing operations are read out in the form of punched paper tape (left) or automatically printed out on the console typewriter (center).

In manufacturing quality control, the system can be used in analysis and recording of the final test of items such as transistors and refrigerators as they come off the assembly line. Inspection data may be automatically generated with the computer evaluating the unit or group of units, and indicating where modifications of manufacturing steps may be necessary to eliminate flaws.

The data converter includes a four-digit analog to digital converter and a digital clock which indicates hours, tenths, and hundredths of hours. Both the clock and converter are automatically read by the computer and visually displayed on the converter's control panel.

***Send In Your Reservation Now. We'll See You At The . . .**

Fifth Conference on Manufacturing Automation

April 17-19, 1961—Purdue University, Lafayette, Ind.

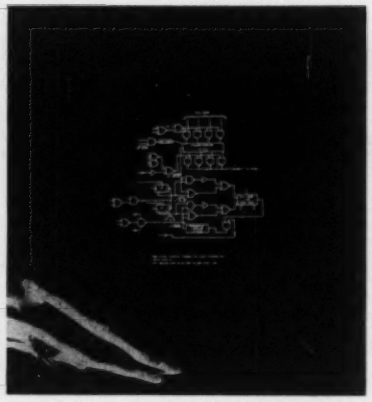
*For Details, See Pages 12 and 166.

Microfilm Recorder Produces Mechanical Drawings

USING information supplied by a computer, equipment now available generates drawings with electron beams and records them on mirofilm. The high-speed microfilm recorder was designed by Stromberg-Carlson, Div., General Dynamics Corp.

Using a mathematical code recorded on magnetic tape by a computer, the recorder draws with electron beams—lines, curves, symbols, and dimensions necessary to make detailed multi-view drawings. Once the engineering specifications are placed in the computer and computer output transferred to the recorder, the recorder will produce drawings of any view or cross-section in three dimensions. It can also provide complex wiring diagrams, layout work, and other processes requiring calculations.

Heart of the printer is a Charactron shaped beam tube. Impulses from the magnetic tape pass through the printer's electronic circuitry, appearing as TV-like displays on the tube. The system automatically records the drawings on 35 mm microfilm in less than one-half second. Versatility of this tube permits drawing straight lines, arcs, circles, dotted lines, arrow heads, letters of the alphabet, numbers, and various other symbols. The microfilm recorder can record data on microfilm at 17,500 characters per second and plot graphs on microfilm at 12,500 points per second.



High-speed microfilm recorder can produce mechanical drawings (illustration shows a logic circuit diagram) on the face on a 7-inch Charactron shaped beam tube. The system records the drawing on 35 mm microfilm in less than one-half second.

Package Design Unfolds New Applications

PACKAGING MACHINE which forms, fills, and seals in one continuous operation has been added to the product line of Bemis Bro. Bag Co. The package is a tetrahedron-shaped flexible unit formed by four triangular faces joining in a pyramid type shape. Using the same amount of material, a tetrahedron provides up to 100 per cent greater capacity than a standard pouch form container. Its application is seen for products in container sizes from $\frac{1}{3}$ ounce to a quart. The machine is capable of intermittent product filling, making it possible to package powders, liquids, and semi-liquids in the tetrahedron form.

The machine can produce from 140 to 250 packets per minute, and it can use almost any roll form of heat-sealing material. The use of roll stock material is expected to save warehouse space and reduce package weight by up to 90 per cent. The machines will be leased on a long term license.

POSITIONING AND PROGRAMMING system for metalworking operations has been designed by Sanders Associates Inc. The system positions and controls machine tool work on loads as heavy as 6 tons and lengths up to 150 feet at speeds up to 150 fpm with an accuracy of 1/32 inch over the full 150-foot length. A single card programs up to 60 selected positions and from 1 to 20 operations or processes at each position. The system is controlled by an electro-hydraulic servo valve. Punched tape, magnetic tape, or computers can be easily adapted to the system to meet individual specifications.

Manufacturing Engineering Course Given

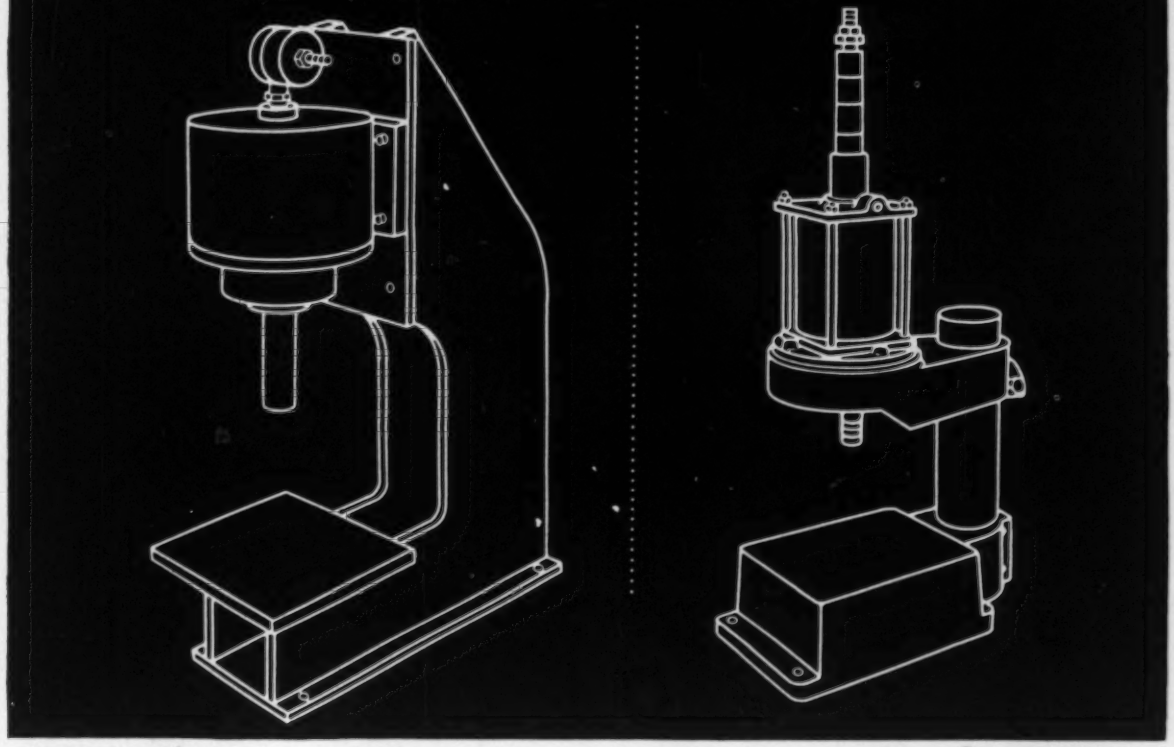
FUNDAMENTALS of manufacturing engineering is a course being given to engineers and scientists of Bell Telephone Laboratories. The course, called Manufacturing Information for Laboratories Engineers (MILE) stemmed from an educational program that was initiated at the Allentown Works between the Western Electric Manufacturing Engineering Organization and the Allentown Laboratory of the Bell Telephone Laboratories. The program provides a sharing of technical knowledge in an efficient orderly manner in order to secure an increasingly effective interplay between engineers whose chief responsibilities are manufacturing methods and functional design objectives respectively.

The MILE program offers information on the economics, planning, and technology of manufacture. Engineers from the laboratory are also given short term assignments in selected product engineering jobs. Participants in the MILE program expressed the opinion that it accomplished its purpose in providing useful information on the design of competitive products. In addition, the Western Electric engineers who prepared the course and taught it have benefited from having to define their job responsibilities and engineering

AUTOMATION Product Review

SECOND EDITION of the AUTOMATION Product Review is nearing its completion stages. Distribution of this booklet to all regular recipients of AUTOMATION will be made in May. The review will contain information on automation equipment, products, components, and services which are available from advertisers in AUTOMATION. For easy reference, there will be a product index and classification, along with a company index.

SINGLE AND DOUBLE-ACTING AIR PRESSES
FIXED AND VARIABLE "DAYLIGHT" SETTINGS
¼ TO 1¾ TON CAPACITIES



How MEAD air presses put the SQUEEZE on production costs

Fast-acting MEAD bench presses put new economy into a wide variety of everyday operations like assembling, staking, crimping and riveting. The broad line of MEAD air actuated models covers virtually all small press requirements. Press capacities begin at ¼ ton and grow to 1¾ tons by fractional increments. The sturdily designed double or single-acting operating cylinders may be mounted in one of three fixed positions on a rigid plate, as shown on the above left. The picture on the right shows how a cylinder may be attached to a solid steel column for vertical or radial movement. To press more profit out of your production, check with MEAD.

ASK YOUR MEAD MAN
for more dollar-saving automation ideas

PRODUCTS FOR AUTOMATION
MEAD
FLUID DYNAMICS
A DIVISION OF MEAD SPECIALTIES CO.
4114 N. KNOX AVE., Dept. 241 CHICAGO 41, ILL.

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Fifth Conference on Manufacturing Automation

APRIL 17, 18, 19

V. C. BLECKER

W. F. WILLIAMS

A. A. HIGHLAND

DR. J. G. HUTTON

FIRST SESSION of the Fifth Conference on Manufacturing Automation begins Monday morning, April 17 on the campus of Purdue University, Lafayette, Ind. Planned around the basic interests and questions brought out at previous conferences, the 3-day event is again expected to have in attendance top management and manufacturing engineers who plan, design, and install automated systems for industry.

The four main areas of automation technology to be covered include: Organization and Costs, The Process, Handling in Process, and Control of Operations. Outstanding authorities will present papers on the following subjects:

Dr. J. G. Hutton, General Manager, Specialty Control Dept., General Electric Co. will discuss *Plans and Policies for Automation . . . Comprehensive Analysis of an Automation Project* will be presented in three parts. **E. H. Grumich,** Chief Engineer, Parker Pen Co. will cover *Shall We Automate?,* **C. C. Holloway,** President, Gilman Engineering & Mfg. Co. will speak on the *Preparation of the Proposal,* and **L. C. Tullis,** Chief Engineer, Gilman Engineering & Mfg. Co. will talk on the *Design of the Automated Machine.*

H. R. CHOPE

E. H. GRUMICH

J. R. Wilson Jr., Supt., Production Engineering, AC Spark Plug Div., General Motors Corp. will discuss *Co-ordinating Research, Engineering, and Production Talents for Development of Integrated Equipment . . .* **S. B. Korin,** Corporate Manufacturing Research, International Business Machines Corp. will cover *A Look at Investment and Payback . . .* **N. O. Olesten,** Numerical Control Supervisor, Rohr Aircraft Co. will speak on *Management Aspects of Numerical Control . . .*

J. R. HUMPHREY

C. C. HOLLOWAY

W. Herdlein, Executive Vice President, Manager, Industrial Div., R. C. Mahon Co. will discuss *Automatic Finishing Operations . . .* **F. E. Stote,** Manager, Division Manufacturing Services, Texas Instruments Inc. will speak on the *Automated Production of Transistors . . .* **L. W. Myers,** Assistant Supt. Mfg. Engineering, Omaha Works, Western Electric Co. will talk on the *Continuous Filament and Web Processes.*

J. P. TEAS

M. C. Irish, Chief Product Engineer, National Automatic Tool Co. Inc. will cover *Transferring Methods . . .* **J. P. Teas,** Technical Director, Flood Co. will discuss *Balancing Production Lines by Banking and Storage Between Operations . . .* **J. R. Humphrey,** General Manager, Humphrey Design & Mfg. Inc. will speak on *Tricks in Handling Paper Products.*

L. C. TULLIS

H. R. Chope, Executive Vice President, Industrial Nucleonics Corp. will talk on *Developing Controls for Automated Equipment on a Systems Basis . . .* **A. A. Highland,** Industrial Product Planner, Computer Dept., General Electric Co. and **W. F. Williams,** Senior Systems Analyst, Computer Dept., General Electric Co. will jointly discuss *Monitoring, Logging, and Control with Data . . .* **V. C. Blecker,** Manager, Industrial Sales Div., Eagle Signal Co. will speak on *Systems to Control Time Cycles.*

M. C. IRISH

Details about reservations available from K. E. Glancy, Div. of Adult Education, Purdue University; or AUTOMATION, Penton Bldg., Cleveland 13, Ohio.

J. R. WILSON JR.

S. B. KORIN

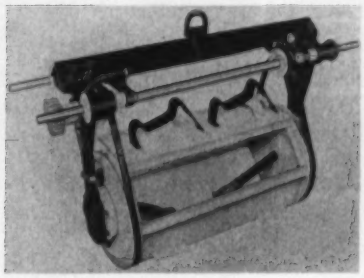
N. O. OLESTEN

W. HERDLEIN

F. E. STOTE

L. W. MYERS

principles as well as from the experience of responding to challenges of their opinions raised by fellow professionals.



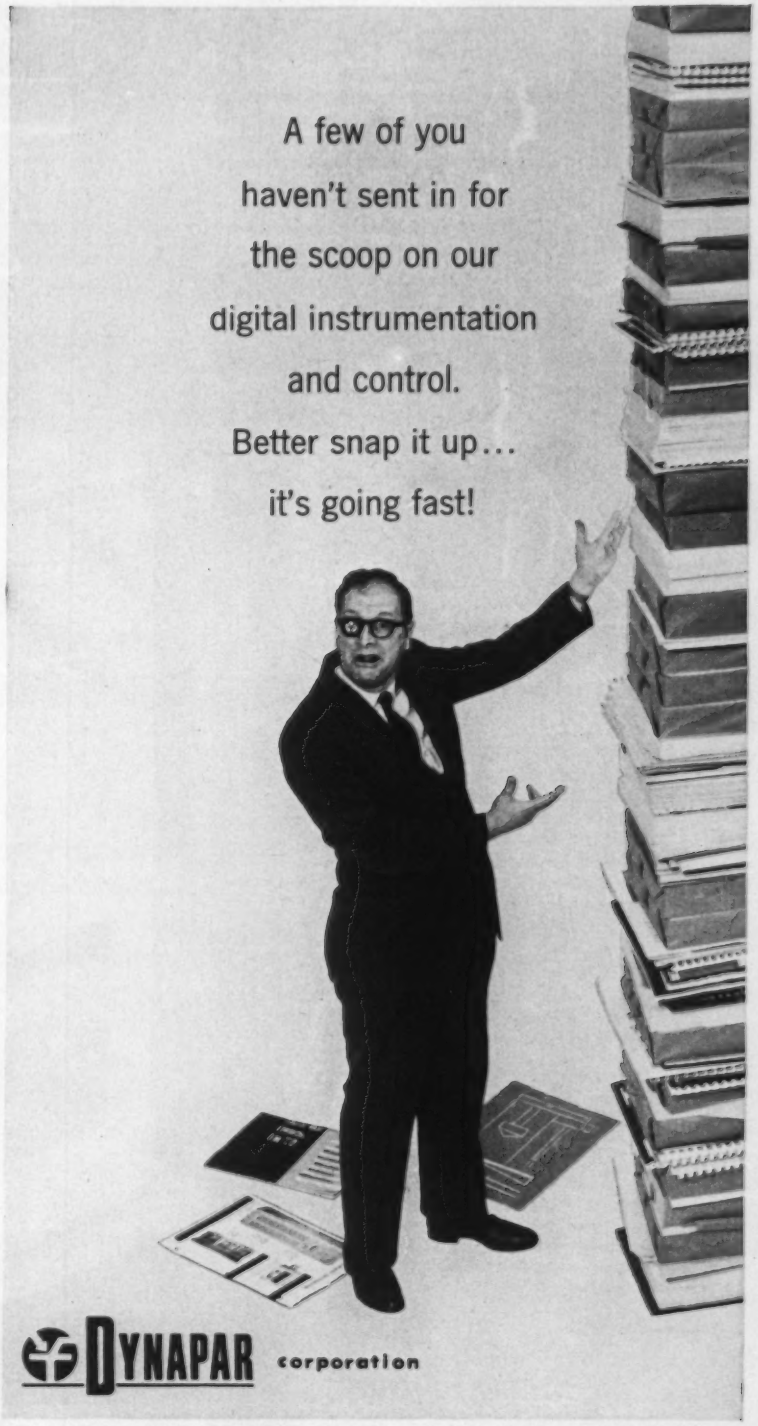
IMPROVED plating barrel has been made with a new material called polypropylene. Developed by Hanson-Van Winkle-Munning Co., the Mercil-type polypropylene barrel is molded in one piece without ribs. Attachments are made with heat welded joints reinforced with stainless steel screws. Panels are ½-inch and perforated to suit customers' specifications. Inside surfaces are convex to add strength and facilitate tumbling. Polypropylene can withstand plating, cleaning, or acid dipping at temperatures up to 200 F.

CONTROLLED two-color spray painting without masking is possible with automatic airless spray guns developed by DeVilbiss Co. Objects can be simultaneously sprayed with two separate colors in a single spray booth. The gun is capable of handling heavy or light paint materials of all types.

Pipe Welding in the Field Now Automatic

PROCESS has been developed for pipeline welding in the field, an operation which will have to be performed approximately every 50 feet on about 27,500 miles of new pipeline this year. Key to the process is a welding device that clamps over and welds two lengths of pipe in as little as one-twentieth of the time required for manual welding.

A caterpillar tractor aids in lifting pipe to be welded and in placing the automatic welder over the pipe ends. The ends are held firmly together and in line by means of a specially devised internal alignment clamp inserted in each pipe. An air-driven abrasive cutting wheel then slices a minute sliver from each of the pipe ends. An arc welder follows in the track of the



Dynapar is the electronic subsidiary of The Louis Allis Co. We make a full line of transistorized digital devices for high-speed counting, measuring, and control.

Information on any of these products can be obtained from your local Louis Allis District Office — which is listed in The Yellow Pages under "Electric Motors."

Draw Indicators

Process Controllers

Rotopulsers

DD-221

DYNAPAR CORP., 463 E. STEWART ST., MILWAUKEE 1, WIS. *A subsidiary of The Louis Allis Co.*

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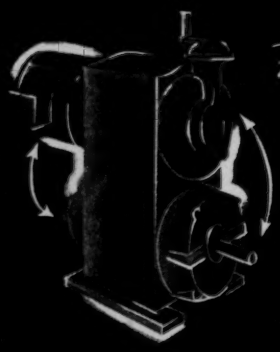
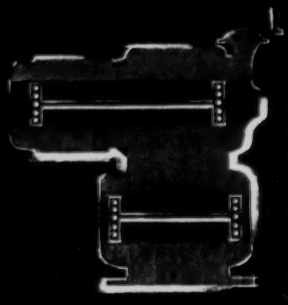


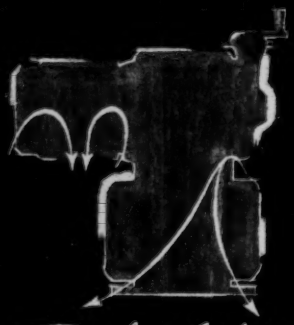
Field Versatility

Mounting feet, end brackets, control hand wheel, conduit box, and output shaft can be relocated in minutes without special tools for wall-, floor- or ceiling-mounting. Components can be changed or controls can be added in the field to meet ever-changing conditions of operation.



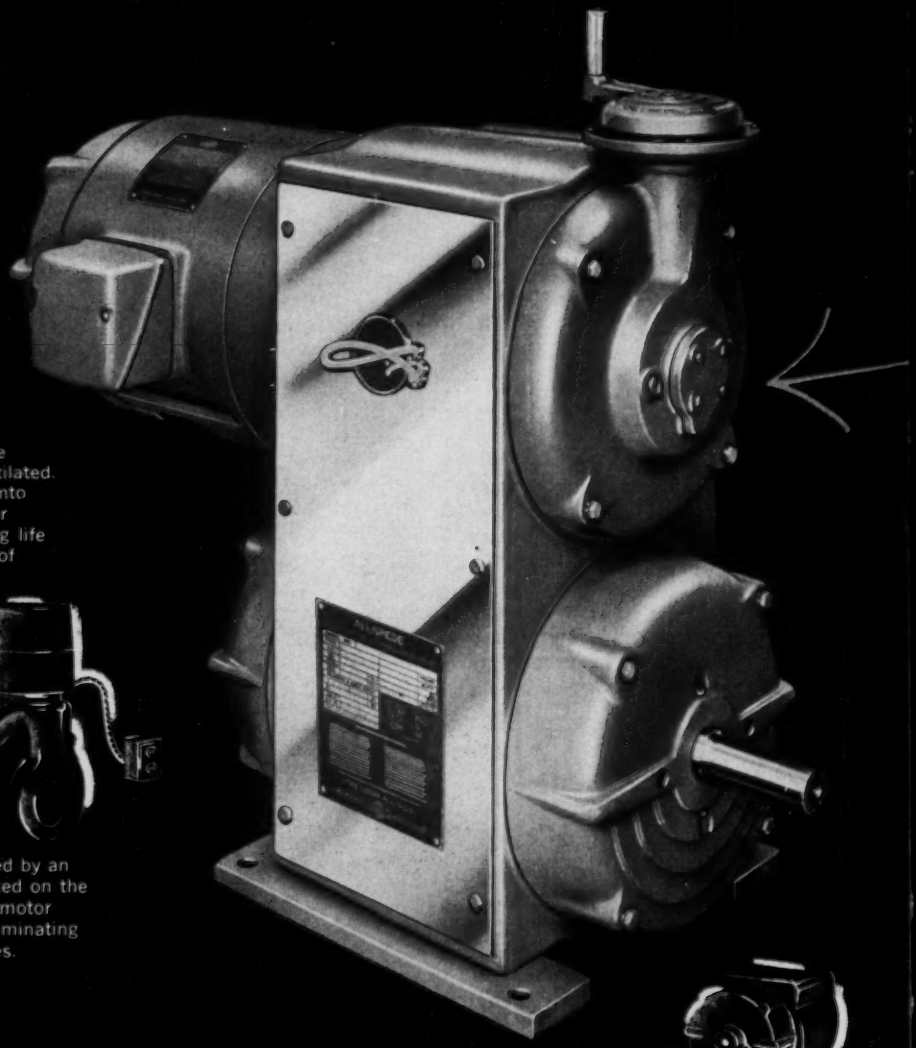
Four-Bearing Design

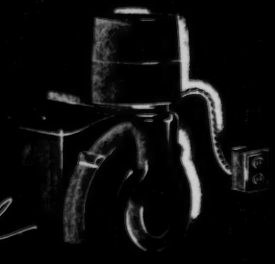
This important design feature eliminates the problems of overhung discs. It equalizes distribution of belt loading — keeps bearings, shafts, discs and belt permanently aligned — improves performance — and extends bearing life.



Dual-Ventilation System

The motor and the belt housing of the ALLISPEDE DRIVE are individually ventilated. Motor ventilating air is not exhausted into the belt housing — belts run cooler for longer life. Service factor and operating life of all components are higher because of lower operating temperatures.



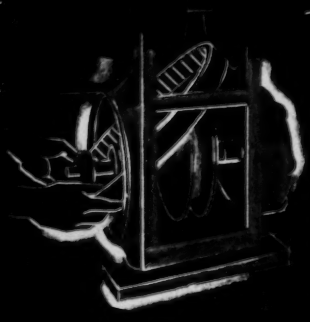


Trouble-Free Remote Control

Electrical remote control can be provided by an enclosed speed-adjusting motor, mounted on the belt-changing mechanism. This torque motor can be stalled without overheating, eliminating the need for troublesome limit switches.

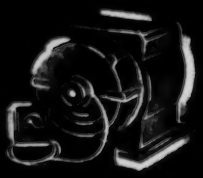
Long Belt Life

Single-cog belts with extra contact area provide more efficient transmission of power and longer belt life. Dual ventilation, precision-machined discs, equalized loading, and automatic belt tension aid in extending belt life.



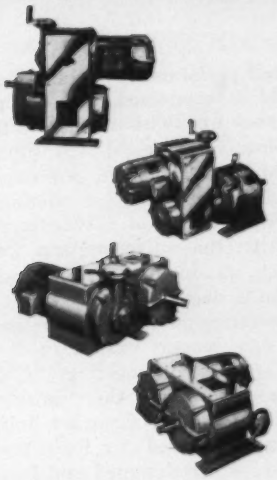
Fast Belt Changing

Belt changing is fast and easy — without requiring special tools. You remove only one bearing bracket and the speed-adjusting mechanism to make fast changes without affecting permanent alignment of discs or belts.



Remote Speed Indication

A tachometer generator mounted on the output shaft operates an indicator that can be mounted at a remote location. Disassembly of the tachometer is not required when making belt changes.



Four of the many variations of mounting available with the ALLISPEDE DRIVE.

Another new product from Louis Allis

Let's look at the features of the
ALLISPEDE DRIVE*

New Louis Allis Drive offers accurate control – maximum belt life – long-run economy – low-cost versatility – ease of installation

After checking the many superior features of this drive, you will prefer the Allispede every time. The illustrations at the left demonstrate the many advantages of design and construction available in this drive.

The Allispede Drive gives you high efficiency and close regulation. Belt tension adjusts automatically — and belt changes are easy and fast. The modern design eliminates overhung discs—maintains belt and disc alignment — results in longer belt life — provides the ultimate in field versatility.

Check the accompanying features — *now!* A phone call to your local Louis Allis District Office will bring a skilled Louis Allis Field Engineer. He will gladly study your drive problem and offer Application Engineering assistance. Or write to Louis Allis Company, 463 East Stewart Street, Milwaukee 1, Wisconsin for a copy of Bulletin 3600.

*ALLISPEDE is a trademark of The Louis Allis Company.

The Complete Line–

Whatever your mechanical drive application requirements, there's an ALLISPEDE DRIVE to match it exactly. Sizes up to 30 HP, output speeds from 1 to 10,000 RPM, and speed ranges up to 8:1. Motors can be open, drip-proof, enclosed, or explosion-proof; with ventilated or enclosed belt housings, suitable for foot, P-base, C- or D-flange mounting on your machine. Available with parallel shaft, or right-angle, integral gear reducers, special shaft extensions, integral magnetic brakes, electrical or mechanical remote control, and other modifications as required to meet the specifications of your application.

MANUFACTURER OF ELECTRIC MOTORS AND ADJUSTABLE SPEED DRIVES

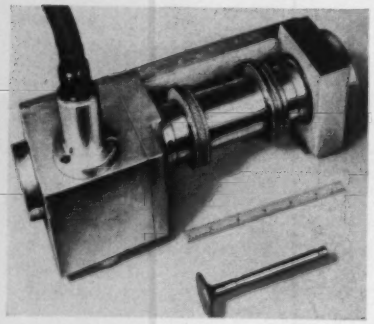
LOUIS ALLIS

Circle 660 on Page 35

ASD-131

cutter and performs the weld. After the weld is completed, the clamp is collapsed and withdrawn to the next joint. On eight-inch pipe, the weld is completed in one minute and is as strong as manual welds requiring up to twenty minutes. After the cutter prepares the pipe ends, no further treatment of any type is needed.

Co-operating in the development of the new process were Esso Research and Engineering Co., Humble Pipe Line Co., Battelle Memorial Institute, Crutcher-Rolfs Cummings Co., and Air Reduction Sales Co., which designed and built the prototype automatic welder.



GRINDING OPERATION on engine valves for automobiles is improved by using rotary diamond set form dressing wheels manufactured by Wheel Trueing Tool Co. The rotary dressing tool dresses the entire face of the grinding wheel in a single pass between the ejection of one production part and the feeding-in of the next. Production with the new trueing method was raised to more than 136,000 parts per grinding wheel compared to 32,000 for the previous single point diamond method.

Transistor Package Simplifies Handling

NEW PACKAGE design for transistors makes it adaptable to mechanized insertion and handling. Developed by Radio Corporation of America, the new package is expected to eliminate delays inherent in packing and unpacking shipments of transistors. The package is a plastic tube with a raised spine or slide-rail running end to end inside along the bottom. Up to twenty-five short-lead computer type transistors can be inserted in the tube, with their cases resting on the rail and their leads just clearing the tube bottom. Perforated, pressure-sensitive tab seals at each end keep the transistors from sliding out of the tube until they are ready for use. The slide-rail provides a means of maintaining the orientation of the transistors.

AUTOMATION NEWS FEATURE

Control System Philosophy

By WILLIAM A. RAY
President and Director of Engineering
General Controls Co.
Glendale, Calif.

As the technology of automation progresses and management turns more and more to automatic controls, there is a growing tendency among many people to feel that automated systems and components must become increasingly more complicated if they are to perform more important functions. Essentially, the function of automation is to increase efficiency, productivity, safety, and comfort by means of a mechanism or a series of related devices. Excessive complexity tends to reduce efficiency, skyrockets the cost of installation and operation, does not improve safety or comfort, and fails to contribute to productivity. Therefore, if automation is to serve its full purpose, simplicity should be foremost in mind when designing and using automated systems.

Another erroneous idea is that unless a device is electronic, it is of little use. There are many elements that are mechanical or electrical which are not only simpler and lower in cost, but are much more reliable. Comparing electronic devices with other types must depend on two basics—economics (Which pays off in terms of cost?) and engineering (Do the requirements of the job to be done permit a choice?). It should be stressed here, however, that electronic methods per se do not necessarily mean greater intricacy.

Simplicity from the user's standpoint takes on broad significance, including simplicity of installation, simplicity of operation, and simplicity of maintenance. Analysis shows that a failure of the control system after installation often comes at inopportune times and the system must be put back into operation immediately. Complicated maintenance procedures only delay its return to service.

Control manufacturers are often asked what course to follow in evaluating a system before installation. The answer to this question hinges on the differentiation between tried systems and those that are making an advancement in the field of automation. If the object is to obtain a system that is conventional, in the sense that no more is expected from it than existing controls can furnish, then the problem is simply one of studying and evaluating known systems, or calling on consultants acquainted with tried approaches.

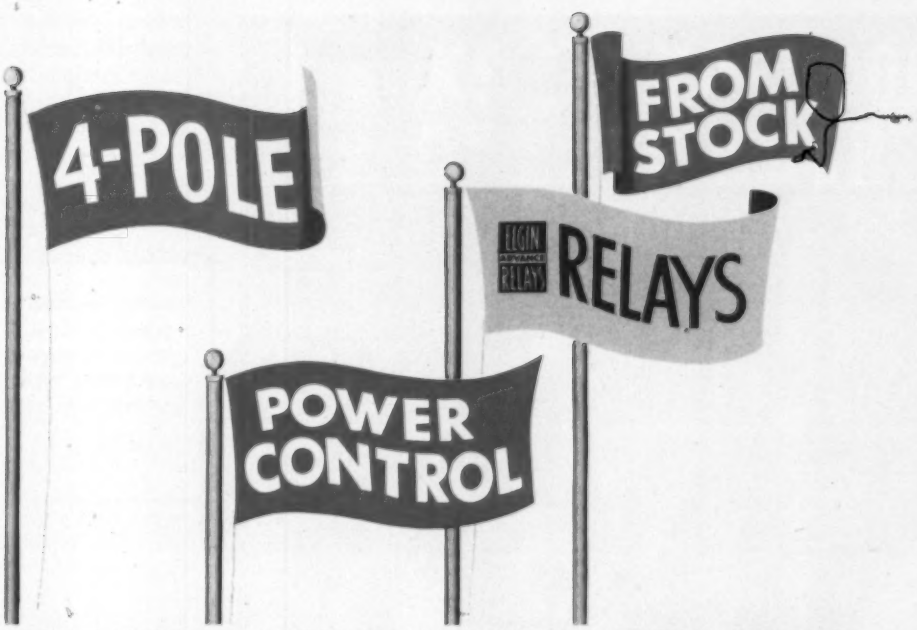
The difficult problem deals with the evaluation of systems which have not been used before or which involve new approaches, faster operation, or require greater safety. In these cases, judgment depends on experiences with past installations and what they can contribute toward the facts which must be considered. Simplicity again, should be a prime factor in measuring a new system. Before full installation, pilot runs should be made whenever possible and practical. Pilot stages can be used in almost every type of application.

Post-installation evaluation depends to a marked degree on figures revealed in the profit and loss statement. This may appear to be an oversimplification, but profit and loss sheets tell the whole and true story. Cost items, such as maintenance, depreciation, component replacement factors, revision of the basic system, and of course, over-all operating results of the installation indicate the degree of effectiveness of the in-use system.

In recent years, miniaturization has become a major practice in the automation field. It is one technique of simplification, but miniaturization does not always mean that a device has been simplified. Sometimes it only means that the components have been compacted into a smaller package. Miniaturization does make possible the development of control components on a modular basis, however, and makes possible their replacement on the same modular basis, permitting easier maintenance. To this extent, miniaturization should definitely add a distinct improvement to control systems.

SPOTLIGHTING PEOPLE

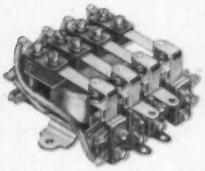
Richard E. Davis and **Maurice E. Grant** have joined Racine Hydraulics & Machinery Inc. to direct phases of the company's high pres-



4-POLE POWER CONTROL RELAYS FROM STOCK

Elgin Advance stocks the only 4-pole power control relay of this type on the market. Specify the PC Series when you require dependable current switching.

The PC Series features heavy load carrying capacity, combined with small size—a variety of contact arrangements—and a wide range of AC and DC coil voltages and resistances.

another example of  **reliable relayability**

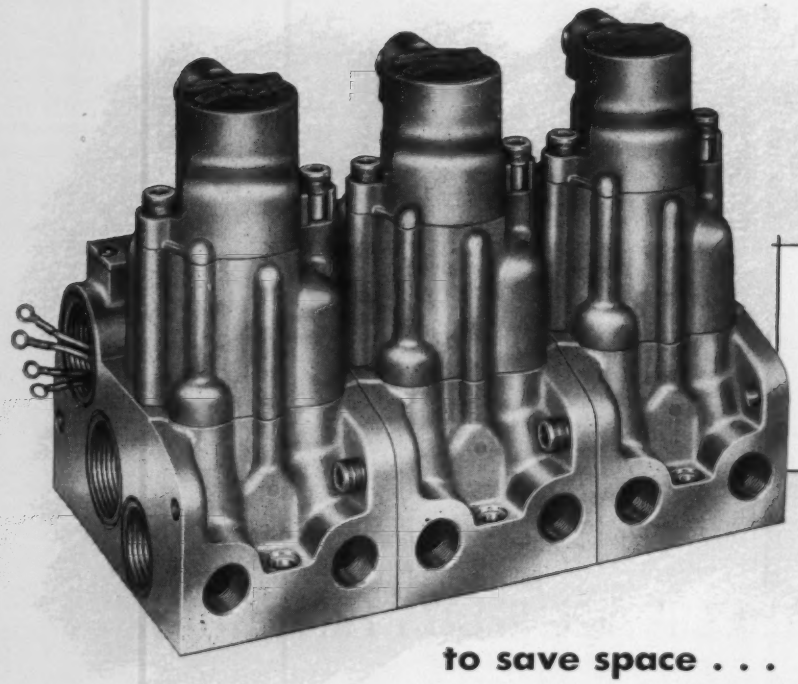
SPECIFICATIONS

Contact arrangements—SPDT, DPDT, 3PDT, 4PDT
Contact rating—15 amps resistive, 5 amps inductive
Contact material—0.25" dia fine silver
Coil voltages & resistances—wide range of AC and DC
AC power—10-12 VA, nominal
DC power—2-3 watts, nominal
Dimensions—1.906" x 3.062" x 2.593", maximum
Weight—8 ounces, maximum

send for **latest data**

ELGIN advance RELAYS
THE ELECTRONICS DIVISION OF ELGIN NATIONAL WATCH COMPANY
2435 NORTH NAOMI STREET, BURBANK, CALIFORNIA

Circle 661 on Page 35



Cylinder ports side and bottom tapped, ⅜, ½ or ¾ in. NPT; through ports tapped both ends and bottom, supply—1 in. NPT, exhaust and wiring conduit ports—1¼ in. NPT; meets JIC Standards.

to save space . . .

to simplify piping and wiring

New PDQ MODULAR MANIFOLD BASE

Now you can save even more space by ganging already-compact Hunt ½ in. PDQ valves on modular manifold bases!

Featuring common supply, exhaust and wiring conduit ports, PDQ modular manifold bases can be ganged end-to-end to manifold two or more valves in a single, compact assembly. Manifolding of valves simplifies supply and exhaust piping, reduces installation costs and minimizes mounting space requirements for multiple valve installations. Modular design permits adding or removing valves at a later date, to meet changing requirements. Also, bottom tapping permits additional supply, exhaust, or wiring connections at any point along the manifold assembly, if required.

Electrical connections, valve-to-base, are plug-in, to reduce downtime to a minimum. What's more, the bayonet-lock construction of Hunt's PDQ valve allows removal and installation of valve and pilot assembly in just 30 seconds, without disturbing piping or wiring.

Whether your problem is limited valve mounting space . . . complex piping . . . high installation costs . . . or you're just looking for better, lower cost, more dependable performance on new or existing equipment, ask your nearby Hunt representative to show you the advantages of modular manifold base-mounted PDQ valves.

For more information, write for Bulletin 602. Address Hunt Valve Company, Salem, Ohio, Dept. AU-461.

HUNT

QUICK-AS-WINK® AIR AND HYDRAULIC

VALVES

HUNT VALVE COMPANY • DIVISION OF IBEC • SALEM, OHIO

3014

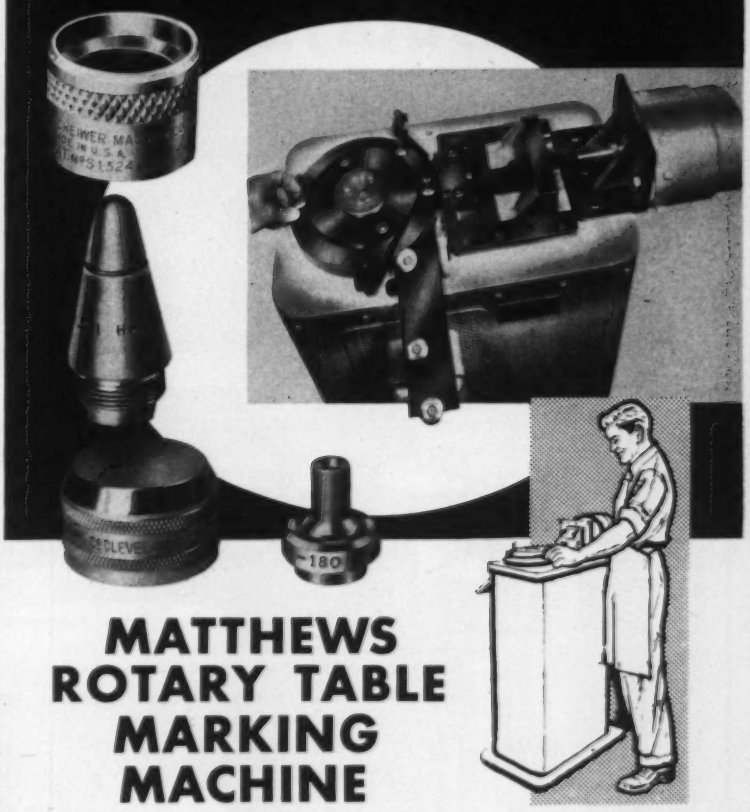
Circle 662 on Page 35

sure pump and controls systems program. . . . **Ernst Wiedman** named director of engineering at Oilgear Co. . . . **Robert W. Cornell** elected executive vice president of Parker-Hannifin Corp. . . . **Harold N. Morris** appointed engineering manager of the new computer systems plant at Radio Corporation of America. . . . **Ralph F. Gow** elected president of Norton Co. . . . **Vern Hedlund,** general manager of the R-B-M Controls Div., Essex Wire Corp. elected president of the National Association of Relay Manufacturers. . . . **Leonard Rosendahl** named head of the applications engineering group on programming equipment at Industrial Timer Corp. . . . **W. W. Harris** appointed administrative manager of the Datalab Division and **Willard F. Bates** appointed director of manufacturing of the Data Recorders Div., both at Consolidated Electrodynamics Corp. . . . **Eugene L. Mackey** named vice president in charge of engineering at the Yoder Co. . . . **William Hibbard** appointed director of applied research of Automation Machines and Equipment Co. Inc. . . . **J. M. Sterling** named factory manager of the Electronic Data Processing Division at Minneapolis-Honeywell Regulator Co. . . . **Dr. Donald C. Brunton** appointed director of research at In-

CATALOG SYSTEM is designed for item look-up by proper page selection and projection on a screen. The system employs a 16 mm film loop driven at a speed of over 40 ips. For a 400-page catalog of 25,000 items, average access time is 1.5 sec. Each frame of the film includes a catalog page and an alphabetic-code for page identification. Selection of the proper page is made by keying the first three letters of the item required. The control keyboard can be any standard electric model. When the third letter is keyed, the film drive starts. The film is automatically stopped when the proper frame is reached, and the page containing the item required is projected on the screen. Unit is manufactured by Ferranti Electric Inc.

MARKS UP TO 7,000 PARTS PER HOUR

. . . Cylindrical or Cone-Shaped
. . . Solid or Tubular Design



MATTHEWS ROTARY TABLE MARKING MACHINE

The Matthews Rotary Table Marking Machine positions, marks, and ejects parts automatically at speeds up to 7,000 per hour. Your name, trade-mark, part number or special lettering appear perfectly even on hard-to-mark, delicate and thin-walled products.

Solid marking dies may be interchanged with steel type or logo dies for variable marking . . . interchangeable machine heads are available for parts of varying size and design. Mark it with a Matthews Rotary Table Marking Machine . . . faster, clearly and more economically. Write for descriptive Bulletin 146-C9.

MATTHEWS MARKING PRODUCTS

JAS. H. MATTHEWS & CO.
3945 FORBES AVENUE • PITTSBURGH 13, PENNA.

Circle 663 on Page 35

new–lube-free...

STERLING
Sealed and shielded bearings require no lubrication.
Keys are fabricated from tough elastic material to eliminate key and keyway wear.
Wear-resistant non-metallic bushings require no lubrication.
Shaft surfaces are corrosion-proof and require no lubrication.
CAUTION

...Sterling's variable speed drive never requires lubrication

Costs Reduced—One of management's biggest headaches has been the development and maintenance of proper lubrication schedules. As a consequence, lubrication problems have long been the cause of variable speed drive failures, pulley wear, sticky pulleys, shortened belt life, excessive noise, and many other equally costly problems.

High labor costs, coupled with increased maintenance needs, are major management problems.

Lubrication Eliminated—Now, Sterling has eliminated all lubrication maintenance problems. No part of a Sterling variable speed drive needs to be lubricated.

All bearings, sealed and shielded, are factory-lubricated and therefore require no lubrication. Shaft surfaces are impregnated with a special exceptionally tough and wear-resistant material which eliminates need for lubrication. The non-metallic bushings are also fabricated from a special material that is equally wear-resistant.

Special Load-Bearing Surfaces—At no time do these surfaces require any attention. Even the keys are fabricated from a tough elastic material and will not wear out.

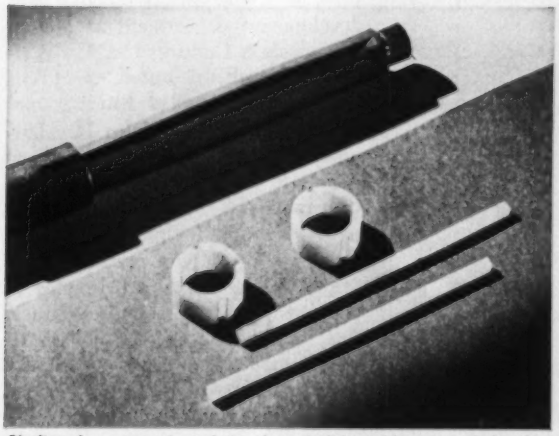
Fret corrosion, long a problem with metallic load-bearing surfaces, is completely eliminated since non-metallic surfaces now carry the load. Sticky pulleys, frequently the result of improper lubrication, are no longer a problem.

Sterling's new "Lube-Free" variable speed drive can be installed in any location, no matter how inaccessible, since lubrication maintenance is no longer needed.

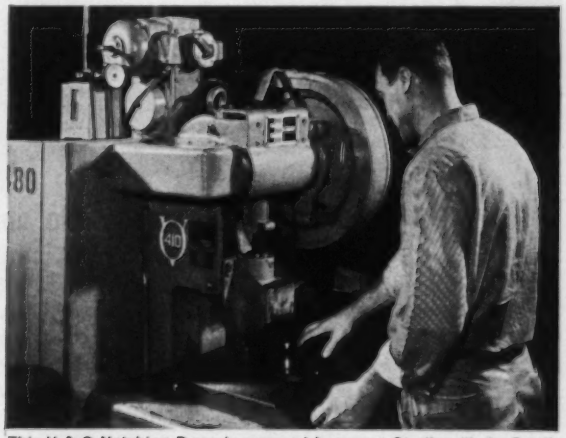
Other Benefits—Costs are reduced, money saved, when lubrication maintenance is no longer necessary. Belt life is lengthened; pulley wear is eliminated. Bearing life may also be lengthened by the elimination of worn pulleys—often the cause of vibration and bearing wear.

All other Sterling variable speed advantages are present in this new "Lube-Free" drive: wide range of speeds, heavy duty cast iron case, finger-tip speed control, etc.

Information Available—Complete application and product information is available by writing Dept. B-9, Sterling Electric Motors, Inc., 5401 Telegraph Road, Los Angeles 22, California—or by contacting the Sterling field engineer in your area.



Shaft surfaces are extremely tough; material provides unusual chemical resistance and anti-frictional properties that make an excellent load-bearing material operating under extremely low or high temperatures. Keys and bushings are fabricated from a material proven to have outstanding abrasion resistance; holds up indefinitely under frictional conditions, thus eliminating need for lubrication.



This V & O Notching Press is powered by a new Sterling "Lube-Free" variable speed drive. It will never need lubrication. Similar units have been installed in the food processing industry. The elimination of lubrication is particularly important in the food processing industry where variable speed drives have such wide application, and where oil and grease create sanitation problems.

Hathaway INSTRUMENTS INC.

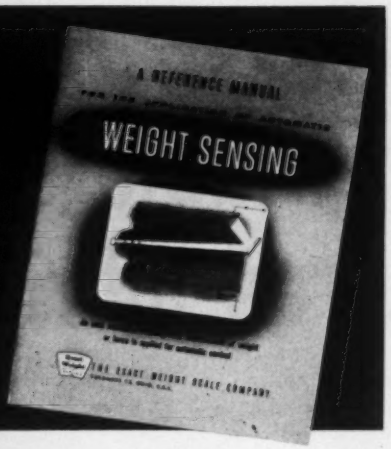
©1961 Sterling Electric Motors, Inc.

Sterling Electric Motors, Inc.

5401 TELEGRAPH ROAD, LOS ANGELES 22, CALIFORNIA,
A Subsidiary of HATHAWAY INSTRUMENTS, INC.

Circle 664 on Page 35

SEND FOR THIS NEW FREE MANUAL



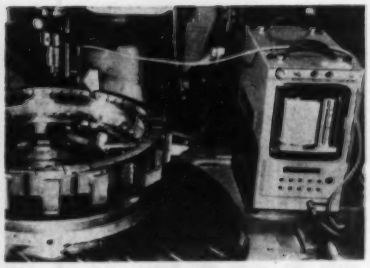
It shows you how measurement of weight or force is applied for AUTOMATIC CONTROL

It's FREE! No obligation

This valuable new reference manual, packed with explanatory diagrams, presents many control possibilities offered by a proven weight-sensing principle. It shows how the principle is applied for control of basic operative functions in automated machines; for control of processing equipment; and for quality control operations. Here is a source of ideas that can lead to the solution of problems concerned with weighing or control by weights. Write for your free copy of "Weight Sensing."

Exact Weight SCALES

THE EXACT WEIGHT SCALE CO.
907 W. FIFTH AVE., COLUMBUS 8, OHIO
In Canada: 5 Six Points Road, Toronto 18, Ont.



PNEUMATIC GAGE recorder unit, manufactured by Sheffield Corp., is used on automatic indexing jig bore machines at General Electric Co. Use of the recorder forewarns of things such as tool wear and possible tool breakdown. The recorder is equipped with maximum and minimum tolerance lights, index chart drive, and a buzzer signal. An adjustable bracket is mounted to the quill of the jig bore to hold a floating spring-urged air spindle. After the first hole is bored, the air spindle automatically gages and records the size. If the size exceeds a preset limit, the recorder buzzer sounds, warning the operator to make the necessary adjustments before the boring tool starts to enter the next hole.

dustrial Nucleonics Corp. . . . **William E. Vannah** named associate for advanced engineering of Foxboro Co. . . . **Robert J. Maguire** appointed manager, systems planning for the industrial products division of Automatic Electric Sales Corp. . . . **Matthew Gould** will direct the development of chemical equipment in the chemical research and development department at Hagan Chemicals & Controls Inc. . . . **Walter H. Powell** appointed vice president of operations of International Resistance Co. . . . **John H. Hennessy** named vice president and assistant to the president at Nuclear-Chicago Corp. . . . **William Christensen** joined Performance Measurements Co. as vice president. . . . **Steven Heller** appointed director of engineering at Glascote Products Inc., subsidiary of A. O. Smith Corp. . . . **Dr. Robert C. Gore** joined the Instrument Div., Perkin-Elmer Corp. as product specialist in molecular spectroscopy. . . . **M. W. Griffes** appointed director of engineering and **Clive Yeomans** named director of advanced research, both at Euclid Electric & Mfg. Co. . . . **Stuart O. Schaefer** named Detroit plant industrial engineer and **Richard L. Watterson** appointed plant industrial engineer at Louisville, both in the Industrial Engineering Dept., Stainless and Strip

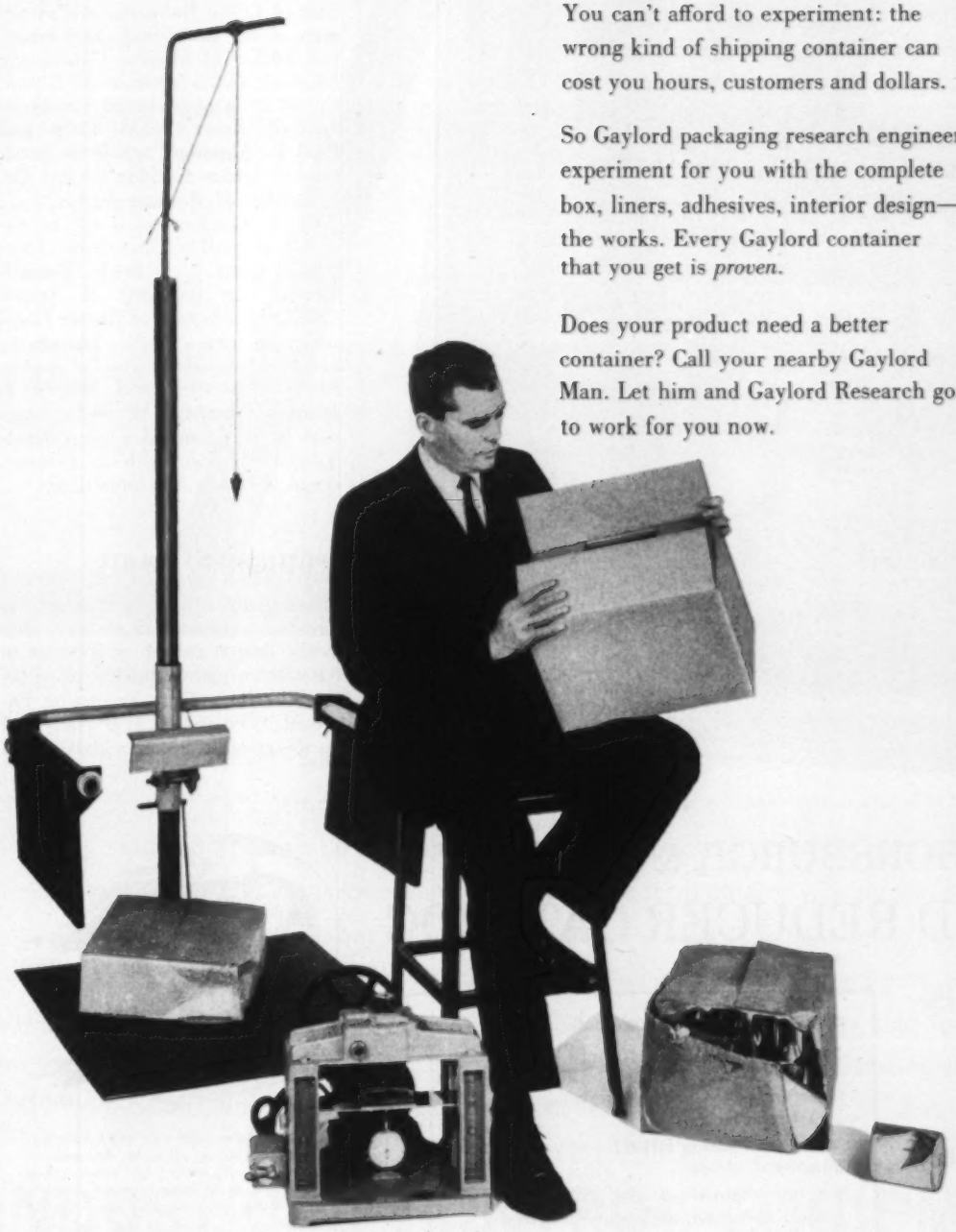
Circle 665 on Page 35

GAYLORD
researches out the failures

You can't afford to experiment: the wrong kind of shipping container can cost you hours, customers and dollars.

So Gaylord packaging research engineers experiment for you with the complete box, liners, adhesives, interior design—the works. Every Gaylord container that you get is *proven*.

Does your product need a better container? Call your nearby Gaylord Man. Let him and Gaylord Research go to work for you now.



CROWN ZELLERBACH CORPORATION
GAYLORD CONTAINER DIVISION

IN CANADA · CROWN ZELLERBACH CANADA, LTD. VANCOUVER, B. C.

HEADQUARTERS, ST. LOUIS
PLANTS COAST TO COAST

Circle 666 on Page 35

Introducing . . .

. . . A New

HORSBURGH & SCOTT

SPEED REDUCER CATALOG

To Simplify Selection of Speed Reducers for Industry

New catalog features include:

New Sizes • Improved Ratings • More Ratios • Latest AGMA Thermal Ratings • Simplified Selection • Easy-to-use Overhung Load Ratings • Steel Housings.

Write for **Catalog HH-61**—on your company letterhead, please.

Let our engineering staff give you prompt assistance with your enclosed gearing requirements.

H&S

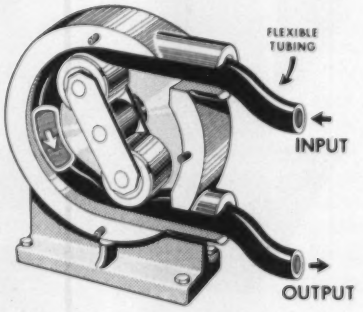
The HORSBURGH & SCOTT Co.

5112 Hamilton Avenue • Cleveland 14, Ohio

Div. at Jones & Laughlin Steel Corp. . . . **Jose Joaquin Quintero** named manager of the International Division of Fischer & Porter Co. . . . **William F. Cairns** appointed manager of the Cambridge Division of Airpax Electronics Inc. . . . **Fred R. Sullivan** named senior vice president of Litton Industries and chairman of the board and chief executive officer of Monroe Calculating Machine Co. a division of Litton. . . . **H. D. Kinsey** elected vice president of Union Carbide Corp. and **Paul L. Alspaugh** appointed president of Union Carbide Olefins Co. a division of the corporation. . . . **John A. Gosden** appointed to the technical staff of Auerbach Electronics Corp. . . . **Erwin Tomash** elected vice president of Ampex Corp. and manager of Ampex Computer Products Co. . . . **Lincoln L. Horn** appointed director of manufacturing services and **Harold J. Johnson** promoted to senior engineer in the advanced systems development division, both at International Business Machines Corp.

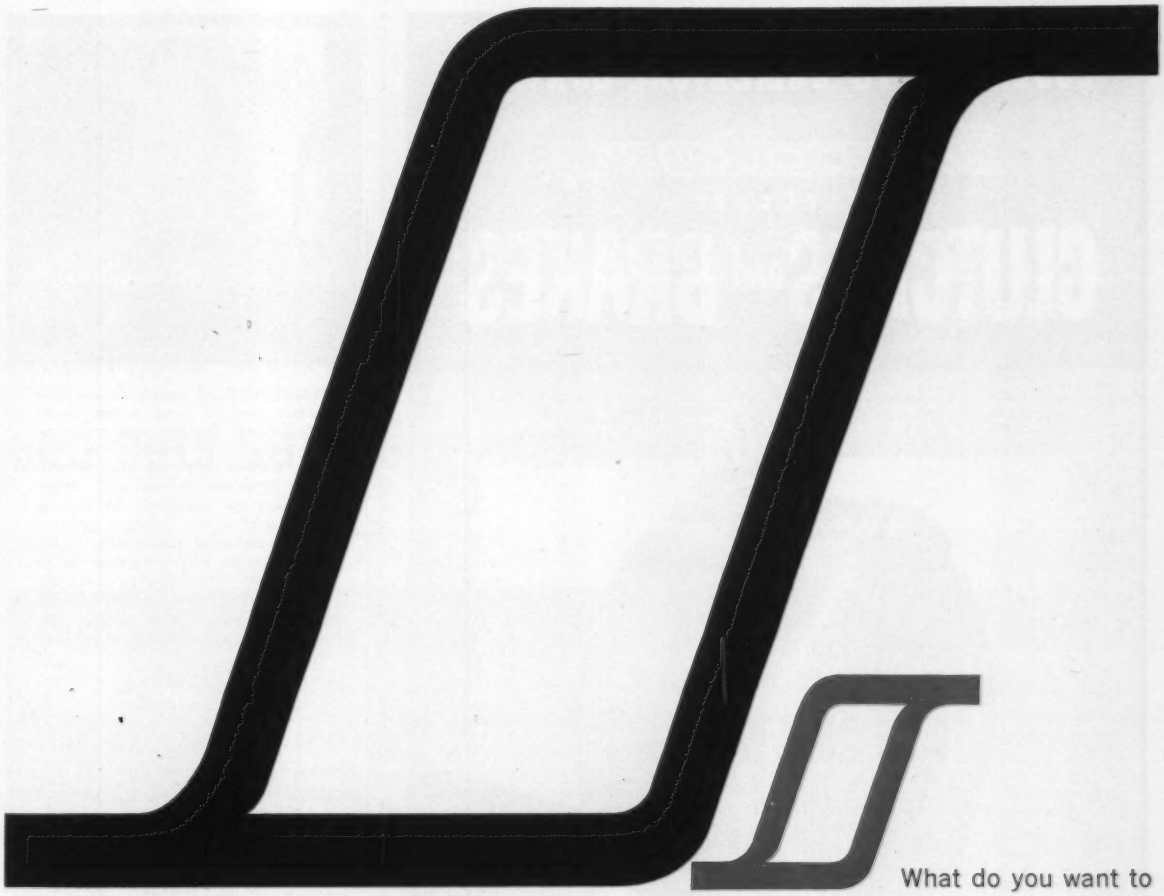
SPOTLIGHTING PLANTS

Minneapolis - Honeywell Regulator Co. has purchased 48 acres of land in the Boston suburb of Billerica to construct a manufacturing plant for the Electronic Data Processing Division. The 75,000 sq ft plant will be designed to accommodate up to



PUMP, shown with side plate removed, operates on a principle designed to eliminate all contact of moving parts with the fluid being pumped. Intake and outlet are one continuous flexible tube which passes through the pump body where it is exposed to the squeegee action of ball-bearing rollers. By selecting tubing material suitable to the liquid being handled, a wide variety of corrosive, sterile, and abrasive liquids or gases can be pumped without contamination or injury to the pump. Unit is manufactured by the Randolph Co.

Circle 667 on Page 35



What do you want to control? The flow and measure of 20,000 amperes in an aluminum ore processing plant? (A large static control system will provide pinpoint control—and eliminate the need for direct connections between meter panel and bus bar.) Or do you want to supply exact change in an automatic bill-changer? (A small static control system will do this—and detect counterfeits to boot!) Large system or small, static control can be the answer. ■ We show large and small hysteresis loops to define these systems as *magnetic* static control. Such systems have no moving parts (static), and under normal operating conditions will never burn out or wear out. There is virtually no maintenance needed, almost no heat loss, and fewer components than in conventional systems. Static control systems are used on automobile assembly lines, for annunciator systems, and for controlling the speed of 1/20-hp motors. If you, too, would like to learn what your operating statistics and costs could be by using magnetic static control, write to Magnetics Inc., Dept. A-87, Butler, Pa.

INDUSTRIAL CONTROL EQUIPMENT

MAGNETICS inc.®

ESSENTIAL TO NUMERICAL CONTROL

Maxitorq

ELECTRIC

CLUTCHES and BRAKES

COMPACT DESIGN • FAST RESPONSE
POSITIVE REMOTE CONTROL PERFORMANCE

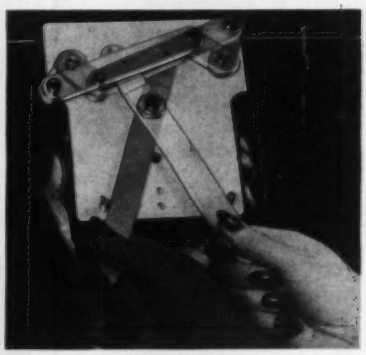
Incorporating advanced design principles proved through years of service, the MAXITORQ Electric Clutch is well adapted to all types of machine drives. Simple in design . . . built to machine tool standards . . . requires no adjustments, can be used either as a clutch or brake. Disc separators not only separate discs, but also break up residual magnetism and result in extremely fast, positive action with no drag or heating in neutral. There are few moving parts. Electrical operating unit remains stationary — hence, no troublesome slip rings, brushes, or difficult wiring problems. Operation is on standard 100 V d.c. Other voltages on special order.

FAST ACTING
POSITIVE ENGAGEMENT and RELEASE
REMOTE CONTROL
COMPACT DESIGN
SELF ADJUSTING
NO TROUBLESOME WIRING

If you have a clutch or brake application where you are looking for NEW and IMPROVED performance, we invite you to bring the problem to us. Phone, wire or write Dept. AT for Bulletin No. 90.

THE CARLYLE JOHNSON MACHINE CO.
MANCHESTER, CONN.

2CJ61



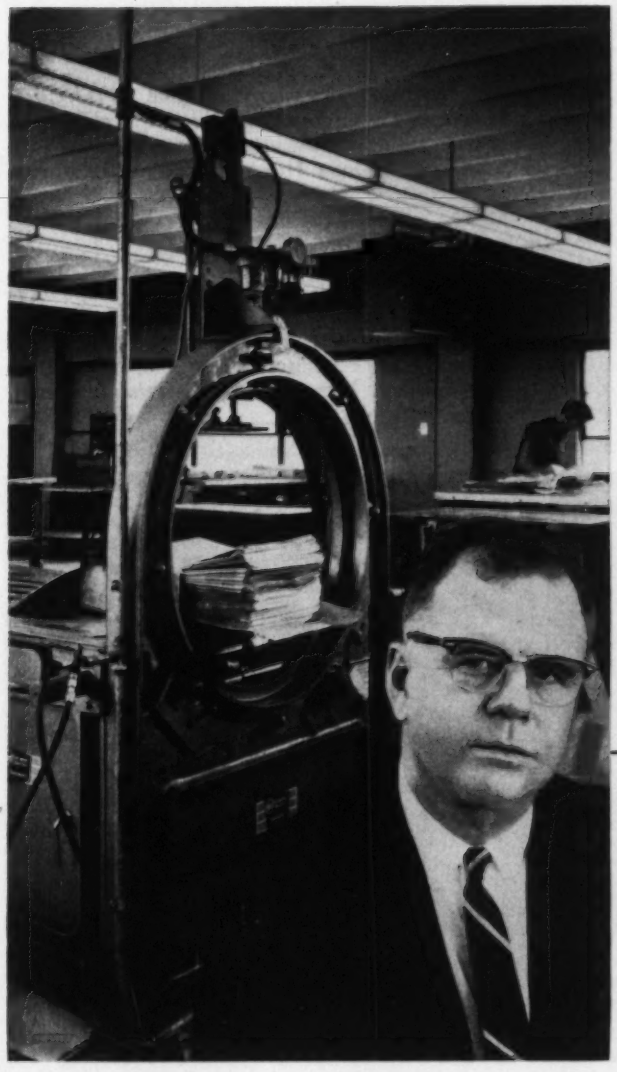
MEASUREMENT of tension in any filamentous material under critical conditions is made possible with an instrument designed by Tensitron Inc. Two outer reference rollers are lifted by moving a hand-lever to one side. When the rollers are separated, the material to be tested is then placed in position. A spring-restrained center roller is depressed by the wire in relation to the wire tension. The deflection is mechanically amplified, providing significant rotation of the indicating pointer, even for a small angular change of the sensing arm.

650 employees. . . . **General Dynamics Corp.** has announced a new division to be called General Dynamics/Electronics. The new division will consolidate electronics activities formerly spread among several divisions. . . . **Aluminum Company of America** has announced that expansion at its Davenport, Iowa works is nearing completion. The expansion will enable Alcoa to produce unprinted foil in combinations with paper, wax, paperboard, and plastic materials. . . . **Giannini Controls Corp.** and **Conrac Inc.** have agreed to the sale of the business and assets of Conrac for stock of Giannini, subject to approval of Conrac stockholders. Conrac will be operated under the same management as an independent division of Giannini. . . . **Litton Industries** has announced the purchase of A. Kimball Co., manufacturers of punch-marked tags, labels, punch-markers, and readers. Activities for this equipment will be handled by Monroe Calculating Machine Co., a division of Litton. . . . **Diebel Die & Mfg. Co.** has moved its operations to a new plant in Morton Grove, Ill. The plant occupies 35,000 sq ft of floor space in a single story layout. . . . **Sciaky Bros. Inc.** has transferred its Research Division from Los Angeles to Chicago. Reason for the

Circle 668 on Page 35

IT'S BOUND TO BE BETTER WITH USS STEEL STRAPPING

"This automatic Round Steel Strapping machine doubles wrapping capacity, and cuts strapping costs in half."



"Since we installed the new Model 1200 Automatic Strapping Machine, we have jumped our capacity from 10 to 21 bundles per minute," says Mr. W. R. Cummins, Circulation Director, The Pensacola News-Journal Company, Pensacola, Florida. "And with our previous semi-automatic model we used twice as much round strapping. The new Model 1200 makes a tighter, more compact bundle, and we are now able to use one, rather than two strapping ties."

"With this new machine our circulation can jump to 115,000 without adding help," continued Mr. Cummins. "And since we installed the Model 1200, we've had trouble-free service."

The completely automatic Model 1200 compresses, wraps, tensions, and ties both small and large newspaper bundles with lightweight, high tensile, 18-gauge Round Steel Strapping. This strapping is economical and it holds papers securely. The Pensacola News-Journal Company chose this machine because, like all U. S. Steel Supply installations, it's dependable and it's backed up by always-available, technical service and assistance.

For further information about the advantages of USS Steel Strapping, both round and flat, and the applications of our automatic, semi-automatic, powerized and manually operated tying machines, please send the coupon.

USS TRADEMARK

U. S. Steel Supply Division of United States Steel

U. S. Steel Supply
U. S. Steel Corporation
208 South LaSalle Street
Chicago 4, Illinois

☐ Please send me a copy of your free Sweet's Catalog Insert
☐ Please have a Strapping Specialist call

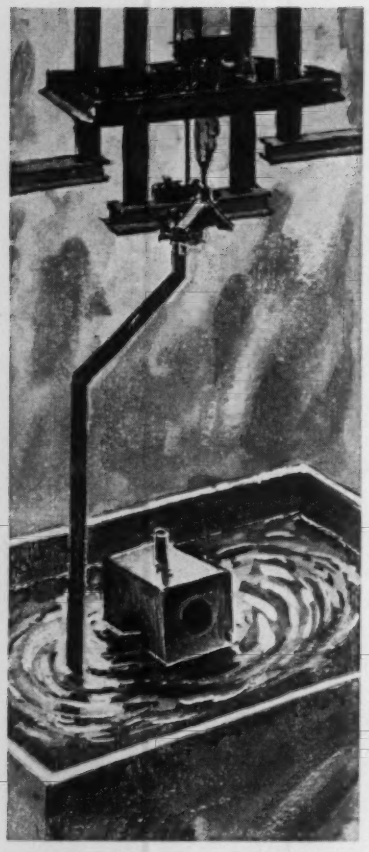
Name _____

Company _____

Address _____

City _____ Zone _____ State _____

Circle 669 on Page 35



GET THE DROP ON COSTS....

The unique vertical drop section in Rapistan Power-and-Free overhead trolley conveyor gives a new answer to old problems.

It lowers parts to assembly height from overhead storage. It serves processing and finishing stations.

It saves floor and tank space, because a dip tank need be only big enough to contain the part, regardless of dip cycle length.

It saves space wherever changes in elevation are required.

For information on the vertical drop section and other unique features of Rapistan Power-and-Free conveyors, write to Rapistan-Keystone, Inc., 553 Rapistan Building, Grand Rapids, Mich. Ask for Bulletin 2365.

Rapistan®

OVERHEAD CONVEYORS

Circle 670 on Page 35

change is to centralize and integrate research and development work with the main plant's laboratory and manufacturing activities. . . . **General Electric Co.** has announced formation of a new industrial process control computer business to be part of the Industry Control Dept. The re-assignment of responsibilities from the Computer Dept. at Phoenix, Ariz. is designed to improve service in the industrial area and in the data processing field. . . . **Burtek Inc.** has announced the acquisition of Concord Control Inc., from the Giddings & Lewis Machine Tool Co., and the officers of Concord. Under the terms of the transaction, Concord Control will continue to be a supplier to Giddings & Lewis for numerical control equipment on a sub-contract basis. Concord will also continue to develop new product lines for Burtek. . . . **Collyer Insulated Wire Co.** has begun construction on a 400,000 sq ft plant in Lincoln, R. I. The new plant will consolidate operations now being carried on at four separate locations. . . . **Westinghouse Electric Corp.** is completing construction on a 600,000 sq ft plant in Muncie, Ind. that will manufacture power transformers. First shipment is expected to be made in late 1961. . . . **Sprout-Waldron & Co. Inc.** has purchased right to a line of feed mill machinery from Helm Mfg. Co. Included in the line are: Pellet mills, pellet coolers and driers, scalping shoes, crumbilizers, and bulk truck bodies. . . . **Jered Industries Inc.**, and its subsidiaries, Jered Equipment Co. and Jered Products have moved into new facilities on a 13-acre site in Birmingham, Mich. The equipment division builds automation equipment for inspection, assembly, and testing operations.

MEETINGS AND EVENTS

Apr. 10-11—

American Society of Mechanical Engineers. Maintenance and plant engineering conference to be held Bancroft Hotel, Worcester, Mass. More information available from society headquarters, 29 W. 39th St., New York 18, N. Y.

Apr. 10-11—

American Institute of Electrical Engineers. Rubber and plastics industries conference to be held Sheraton Hotel, Akron. Details available from society headquarters, 33 West 39th St., New York, N. Y.

Apr. 10-13—

National Packaging Exposition. Sponsored by American Management Association. Conference and exposition to be held at Lakefront Exposition Hall, Chicago. Infor-

OPTICAL TOOL SETTING comparator was designed by Pratt & Whitney Co. Inc. to set tool position in adapters for use in numerically controlled machines or other machine tools requiring fast and frequent tool changes. The unit is a combination comparator and direct setting device which uses a set of reliable gage blocks and end measures for even inch settings. Increments of an inch are set by a micrometer head. Tool point positioning is then observed through the microscope.

RAPISTAN Ideas HANDLING

STEP-BY-STEP ANALYSIS

can cut your handling problems down to size

As with most engineering problems, those involving materials handling often seem less formidable when they are dissected and examined as smaller units of the overall flow system.

Materials handling engineers refer to this principle as "disassociation of inter-related operations"—and, for all its imposing sound, Rapistan sales engineers apply it effectively to analyze a handling problem and arrive at the most practical and economical solution.

When analyzed in this light, any flow pattern can be reduced to a series of identifiable units of movement, interspersed with related periods of storage. To effect the changes from "go" to "stop" and back to "go" again, a number of mechanical or manual transfers must be provided for. Then, all these inter-related steps must be controlled—unified into a coordinated flow system.

In this plant, live storage Flow Rack at the receiving area holds a reserve supply of many materials ultimately destined for storage at the point of use, to accumulate a full payload for fork truck deliveries to work stations. Notice the unique side-loading device on the lift truck, designed for efficient loading and unloading of hatches in the Flow Rack. Live storage also simplifies inspection, paper work, etc. at receiving department.

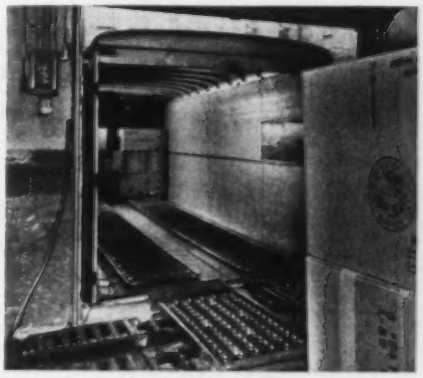
When properly "disassociated", operations that may have been considered as units frequently are found to consist of a number of steps. For example, receiving goods into storage may in reality involve 6 or 8 individual units of movement, transfer and storage.

By treating each of these units as an independently solvable problem, within the framework of the overall flow system, Rapistan handling engineers can recommend the method and equipment that will best mechanize each operation, and best coordinate with preceding and subsequent operations.

This large furniture plant has "disassociated" its receiving operations from production operations. In-coming materials are unloaded directly to platform trucks or pallets by truck drivers. Inspection and receiving forms are completed by company personnel when most convenient.

In analyzing thousands of handling problems, Rapistan engineers have found that the vast majority are closely linked to the storage of goods for long or short periods of time. Improvements in accumulation methods, therefore, promise important economies in equipment, time and manpower for materials handling. This is the area of industrial "warehousing" in which Rapistan engineers have amassed a wealth of practical experience and knowledge.

If you'd like to see some practical suggestions to solve your handling problems based on these principles, call your Rapistan sales engineer. Or, write directly to The RAPIDS-STANDARD CO., Inc., 552 Rapistan Bldg., Grand Rapids 2, Michigan, for our "Handbook of Materials Handling Ideas".



"Disassociation" works in truck loading as well as unloading. Pallet-loads of shipping cases are accumulated on floor-mounted gravity roller conveyor. Company trailers are equipped with matching roller conveyor lines, can be completely loaded in less than a minute, in a single operation.

Rapistan®

CONVEYING EQUIPMENT

Circle 671 on Page 35

PRECISE CONTROL of speed and/or position

with SENECA FALLS systems & components

If you have a control problem of *any* magnitude please find out what Seneca Falls has done and is doing in the field of control and automation techniques.

We offer complete systems from fractional to integral horsepower for control of speed, position, instruments, machines and processes.

We can supply control components . . . sensing devices, tape controls, power and synchronized drives, *and* the mechanical assemblies to be controlled.

Seneca Falls systems are equally suitable for the conversion of existing equipment or the control of new equipment.

If you want design sophistication combined with operating simplicity, call on Seneca Falls.

Write for Bulletin EE 1008. We will also send you our Design Requirements form which will assist you in defining your control problem.

SENECA FALLS MACHINE — PIONEERS IN AUTOMATION

SENECA FALLS, MACHINE CO.
ELECTRONICS DIV. • SENECA FALLS, N. Y.

mation available from association headquarters, 1515 Broadway, Times Square, New York 36, N. Y.

Apr. 11-12—

American Institute of Electrical Engineers. Materials handling conference to be held Pick-Congress Hotel, Chicago. Information available from society headquarters, 33 West 39th St., New York, N. Y.

Apr. 11-13—

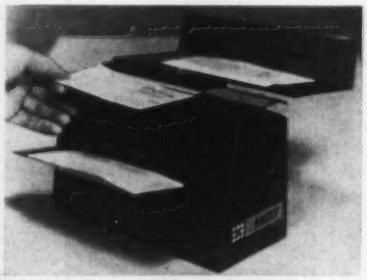
American Society of Lubrication Engineers. Annual meeting to be held Bellevue-Stratford Hotel, Philadelphia. Technical sessions and panel discussions. Additional information available from society headquarters, 5 N. Wabash Ave., Chicago 2, Ill.

Apr. 17-19—

Fifth Conference on Manufacturing Automation. Cosponsored by Purdue University, Manufacturing Engineering Council, and AUTOMATION. To be held at Purdue University, Lafayette, Ind. For additional information contact: K. E. Glancy, Div. of Adult Education, Purdue University; or AUTOMATION, Penton Bldg., Cleveland 13, Ohio.

Apr. 17-19—

Instrument Society of America. Symposium on instrumental methods of analysis to be held Shamrock-Hilton Hotel, Houston. More



PRESSURE-SENSITIVE labels are applied to mutilated checks so that they can be re-encoded for proper processing in automatic check handling equipment. Avery Label Co. developed labels and the machine to apply them to mutilated checks which were rejected by check handling equipment. The labels are attached to the bottom portion of the check, extending it by ⅝ of an inch. This bottom portion is re-encoded, the re-encoded checks are carried through the sorter along the bottom edges, the imprint is scanned, and the checks are sorted, routed, computed, and a balance secured in the same manner as for unmutilated checks.

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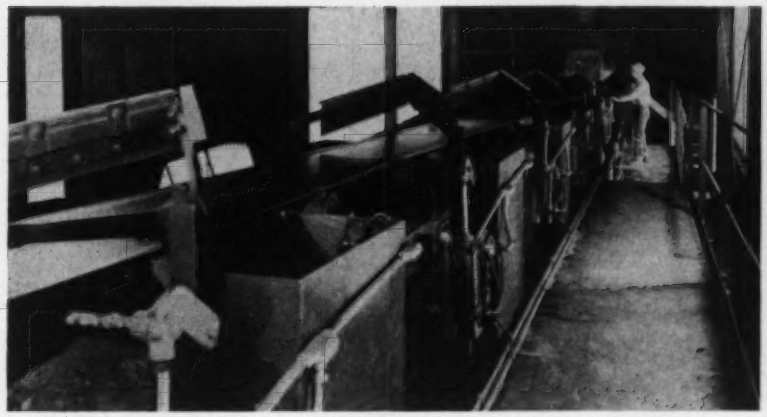


SAND RECLAMATION system is designed to reduce costs and minimize the error factor involved in securing uniform and consistent sand make-up for cores and molds. The system, in use at Empire Steel Castings Inc., has a cooling cascade with special dust control, and a dry type sand reclaimer which reduces the amount of new sand requirements. Automatic control system maintains sand levels at molding stations, sets the plows, secures the proper sand formula and mix, and transfers the sand to individual hoppers (shown in illustration) as required.

details available from society headquarters, 313 Sixth Ave., Pittsburgh 22, Pa.

Apr. 17-21—

American Welding Society. Annual convention and welding exposition to be held at the Commodore Hotel and the New York Coliseum, New York City. Information available from society headquarters, 33 West 39th St., New York 18, N. Y.

Apr. 17-21—

Material Handling Course. Five-day course on Materials Handling in the Metal Forming and Finishing Industry. To be held at the MHEDA National Material Handling Center, Newport, R. I. More information from Mr. Harry Freeman, Director, MHEDA Center, 61 Narragansett Ave., Newport, R. I.

Apr. 19-21—

Institute of Radio Engineers. Southwestern conference and electronic show to be held Baker Hotel and Dallas Memorial Auditorium, Dallas. More information available from society headquarters, 1 East 79th St., New York 21, N. Y.

Apr. 25-27

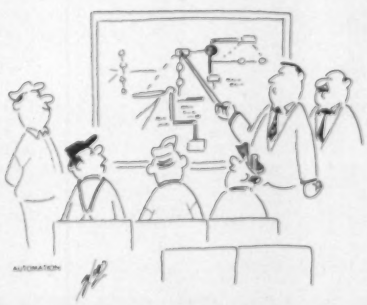
National Conference on Electromagnetic Relays. Cosponsored by the National Association of Relay Manufacturers and the School of Electrical Engineering of Oklahoma State University. To be held at the Student Union Building of Oklahoma State University. Details available from C. F. Cameron, School of Electrical Engineerings, Oklahoma State University, Stillwater, Okla.

Apr. 26-28—

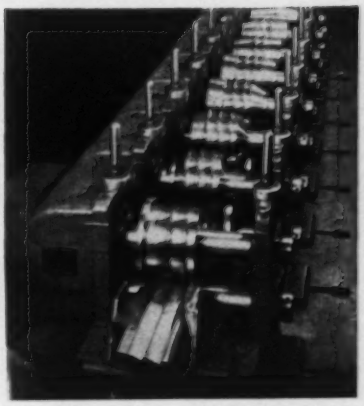
Institute of Radio Engineers. Seventh Region conference and exhibits to be held at Hotel Westward Ho, Phoenix, Ariz. Information from Evertt Eberhard, Motorola Military Electronics Div., 8201 E. McDowell Rd., Scottsdale, Ariz.

May 4-5—

American Institute of Electrical Engineers. Spring textile conference to be held Heart of Atlanta Motel, Atlanta. Details available from society headquarters, 33 West 39th St., New York, N. Y.



"If that part of the machine is supposed to do what Joe Cogslinger does, you'll have to bring it in late every day and leave it in the rest room."



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Yoder Roll-Forming Equipment, even with part-time operation, can effect significant savings in many metal working applications and industries. Shapes, simple or complex, can be quickly and economically produced the Yoder way from a wide variety of flat-rolled coated or uncoated stock ... in thickness up to ¾ inch ... in speeds up to 50,000 feet per day.

Yoder engineers flexibility and precision into metal forming operations. For example: many basic shape modifications, such as coiling, welding, notching, ring-forming, perforating, and cutting to length can be simultaneously accomplished with little or no additional labor cost.

Yoder also makes a complete line of Rotary Slitters and Pipe and Tube Mills. Profit from Yoder's years of engineering and service experience, contact your local Yoder representative or send for the Yoder Roll-Forming Manual.

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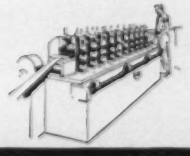

ENGINEERING YODER MANUFACTURING
COLD ROLL FORMING MACHINES

Circle 673 on Page 35

PIN POINT PROGRAMMING

AMP PINBOARDS can do a host of dry circuit switching or commoning functions . . . permit numerous matrixes in one assembly. Complicated switching functions can be accomplished by simply inserting or removing a pin.

You can use these PINBOARDS as modular building blocks for instrumentation applications, automated tooling, test equipment, data processing . . . any variety of size and grid arrangements in multiples of a basic 15 x 5 hole pattern. Contact springs can be bussed in any combination desired. And for safety, there are no exposed conducting surfaces on the rear side of the board. The conducting area of the pin is safely inside board before contact is made with mating springs.

AMP PINBOARDS are factory pre-wired to your specifications . . . with standard or special silk screen legends. Designed for simplicity . . . flexibility . . . reliability . . . with three amperes continuous current rating.

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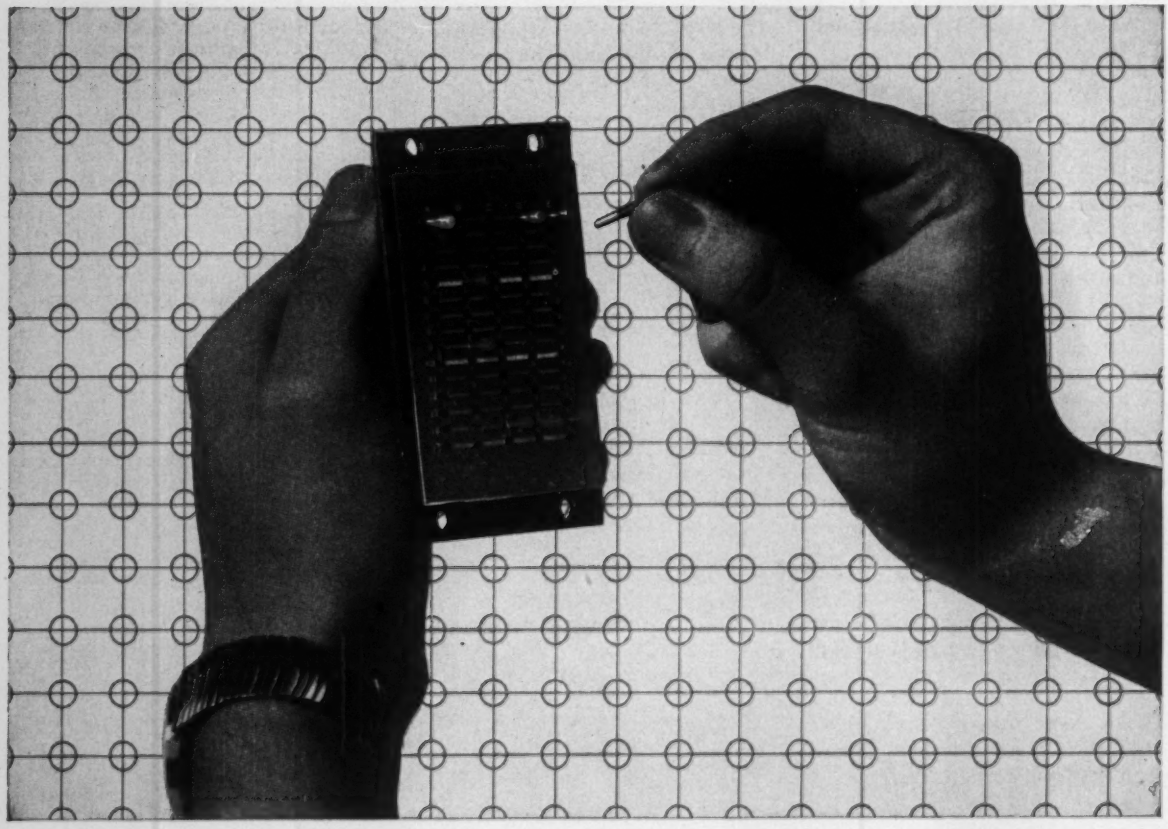

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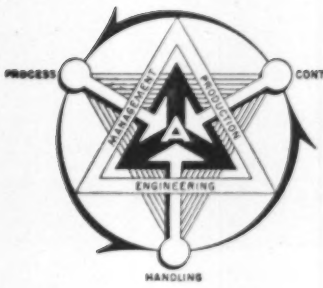

around the triangle

PRESSURIZED BULK TRUCK FOR GRANULAR PRODUCTS

Pressurized bulk truck which handles granular or fine powdered products without contamination, is announced by Sprout, Waldron & Co. Inc. The truck self loads by air polyethylene pellets from hopper cars at the rate of 20 tons per hour and unloads the same material at a rate of 30 tons per hour. It is free from all belts, conveyors, feeders and airlocks, thereby reducing maintenance costs.

ULTRASONIC ENERGY DEBURRS PARTS

Sufficient ultrasonic energy to remove microscopic burrs from machine parts immersed in a deburring medium is provided by a generator developed by Ultrasonic Systems Inc. Parts such as stainless steel screws can be deburred, cleaned, textured, polished and have a symmetric radius created on threads. They are subjected to ultrasonic irradiation for 2-6 hours, depending on the configuration and the degree of perfection required.

TRACING WITHOUT CONTACT

Noncontact tracing technique, developed by Optical Gaging Products Inc., subsidiary, Ex-Cell-O Corp., follows a contour within ±0.0005 inch without touching it. The system will translate this section as a precise 1 to 1 duplicate or trace, which can be on coated glass, plastic, paper, or metal. The electric capacity between the probe and the contoured object controls the probe in its path across the contoured section. Tracing head is motor driven both vertically and horizontally in following the contour, and has automatic servo controls.

COMPUTER CONTROLS CATALYTIC UNIT

A catalytic cracking unit is to be automatically controlled by a digital computer supplied to the Gulf Oil Corp. by TRW Computers Co., div., Thompson Ramo Wooldridge Inc. The computer system is to accomplish automatic closed-loop control over a 60,000-barrel-per-day fluid catalytic cracker in Philadelphia. The principal products of this unit are high octane gasoline stocks, liquid butanes, liquid propanes, and fuel oils. There are 123 analog inputs and 12 analog outputs, with capacity for future expansion. Studies show that operating efficiency will be increased to 95 per cent of theoretical maximum.

TO PRODUCE HIGH-ENERGY-RATE MACHINERY

An agreement to manufacture a line of high-energy-rate metal-forming machinery has been made by U. S. Industries Inc. with Hermes Corp., developers of the equipment. The process used is one in which stored energy is instantaneously released, producing a high-velocity impact, and shaping, in a single blow, metal parts which ordinarily require multiple fabricating operations. This method reduces the size of the equipment required to form large parts, improves dimensional tolerances, and facilitates the making of parts that have not been producible by other methods.

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426	456	486	516	546	576	606	636	666	696	726	756	786	816	846	876
427	457	487	517	547	577	607	637	667	697	727	757	787	817	847	877
428	458	488	518	548	578	608	638	668	698	728	758	788	818	848	878
429	459	489	519	549	579	609	639	669	699	729	759	789	819	849	879
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429 459 489 519 549 579 609 639 669 699 729 759 789 819 849 879
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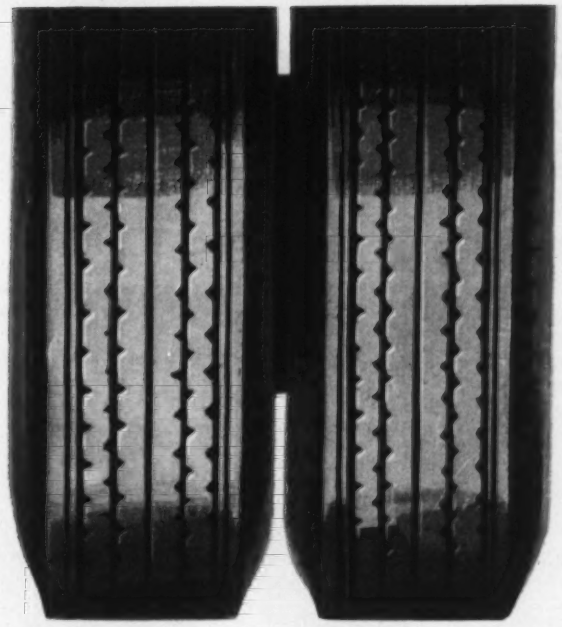


UP PROFITS BY ENDING WEIGHT ERRORS!

FAIRBANKS-MORSE TYPE "S" TRUCK SCALES

Good weighing builds good will—and bigger profits.

Our exclusive Type "S" Truck Scales are famous for accuracy, low maintenance, best load distribution, and minimum installation requirements. They provide greater protection to pivots and bearings under massive loads and sudden stops.

Each Fairbanks-Morse Type "S" Truck Scale is extremely accurate. High-tensile-cast, one piece levers prevent warping, failure, corrosion due to damp scale pits. Exclusive Type "S" design provides super strength, better weight transmission, and protection for sharp knife edges. All parts, including pivots and bearings, are completely interchangeable.

Each Fairbanks-Morse Type "S" Truck Scale is expandable —for longer trucks and larger payloads.

You have a choice of indicators, either Beam type—or our exclusive, swiveling "Floaxial" Dial for fully automatic readouts!

F-M Type "S" Truck Scales range in capacities from 10 to 100 tons and higher. Platform sizes from 18′ x 9′ up to any size required for the weighing of vehicles according to legal limits. Optional accessories include: double face dial; Printomatic for accurate, trouble-free weight recording; and type-registering weighbeam, etc.

For further information, write: **C. G. Gehringer; Scale Division; Fairbanks, Morse & Co.; 19-01 Route 208; Fair Lawn, New Jersey.**

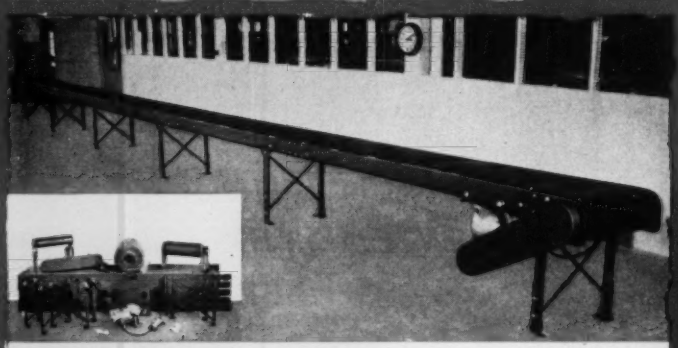
FAIRBANKS MORSE

A MAJOR INDUSTRIAL COMPONENT OF

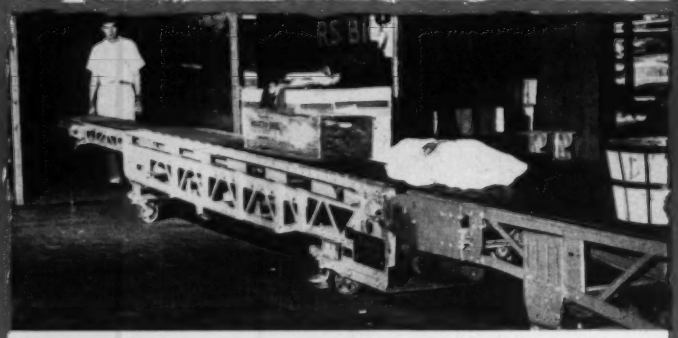
FAIRBANKS WHITNEY

Circle 675 on Page 35

CSI Farquhar
MEMBER



A fast, easy package handling conveyor set up in a few hours! No expensive installations with these CSI-Farquhar standard components. Available either for horizontal or floor-to-floor usage.



The versatile CSI-Farquhar EXPAND-O-VEYOR does a systematized loading job on boxes, crates, bags and other packages. Its built-in stretch gives you the *right* length for every loading situation.

YOUR OWN CUSTOM CONVEYOR SYSTEM with STANDARD COMPONENTS

- Installed in a few hours
- Constant or variable speeds
- Wide selection of lengths
- High capacity, incline or horizontal
- For all kinds of package handling

Here are low cost conveyor units you can use in package handling and loading. Build high capacity conveyor systems with *pre-engineered* CSI-Farquhar units. High efficiency *without high costs!*

Set up a complete flow pattern from assembly line to shipping dock and on into the truck. Select units from the complete line—gravity, power belt, and portable—to make a systematized line *set up the way you want it.*

CONSULT YOUR YELLOW PAGES FOR THE NAME OF YOUR CSI-Farquhar DEALER or WRITE, WIRE or PHONE DIRECT!

SEND FOR COMPLETE DETAILS

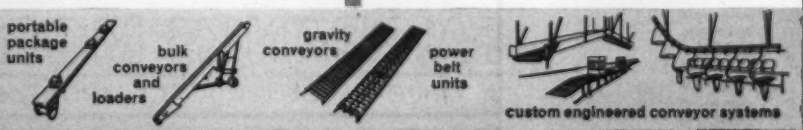
Ask for literature on CSI-Farquhar's complete line of package handling conveyors. Complete with all essential information on specifications, sizes, applications and power requirements. Get your copy today.

CONVEYOR SYSTEMS, INC.
A-B FARQUHAR DIVISION
6453 Main Street
Morton Grove, Illinois
(Chicago Suburb)
Phone: JUniper 8-0200

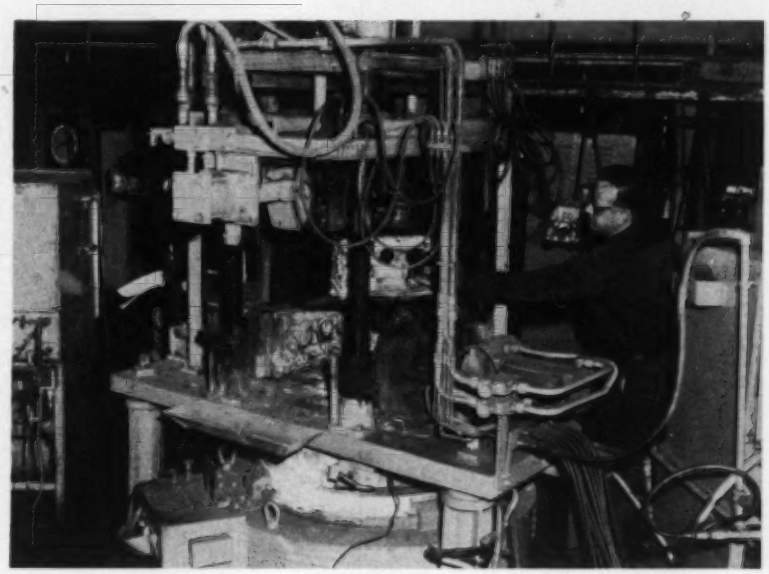
CUSTOM CONVEYOR ENGINEERING

New Brochure No. 70 describes the complete service offered by CSI-Farquhar on engineered installations. It describes and illustrates many complex and specialized conveyor installations designed and built by CSI-Farquhar. Wide experience with all kinds of conveyors—trolley, in-the-floor types, spindle, mesh belt, barrel handling and many others. Our engineers can help you solve your conveyor problem efficiently and economically. Write for new Brochure No. 70 today!

CSI Farquhar MEMBER



THE COMPLETE LINE OF CUSTOM AND PRE-ENGINEERED CONVEYING SYSTEMS



Frankfurt, Germany—Low pressure aluminum casting process developed by Karl Schmidt G.m.b.H., a subsidiary of Metallgesellschaft A.G., produces high density permanent mold castings with a minimum of riser material to be removed. Equipment includes special molds mounted above an electric induction furnace holding molten metal. In operation, casting metal is forced upward from the furnace into the mold cavity through a "stalk" immersed in the molten metal. Air pressure of about 10 psi, applied above the metal in the sealed furnace, supplies the actuating force. After a preset solidification period, the pressure is released and the molten aluminum in the stalk falls back into the melt. The molds are then opened hydraulically and the part is removed. Illustration shows one of 54 such machines used by General Motors Corp. to produce Corvair engine castings. Process is being licensed in the U.S. and Canada by Ladd & Little Inc.

British Tile Making

AN AUTOMATIC factory for the production of colored concrete roofing tiles, to be erected near San Francisco by Jaywoth Permaroof Inc., will be one of the most modern installations of its kind according to Adams Powel Equipment Ltd., supplier of the automatic machinery that will be used. The machinery will be financed by Tile Development Ltd., a company recently formed to promote the sale, in America, of British machines for the production of concrete tile.

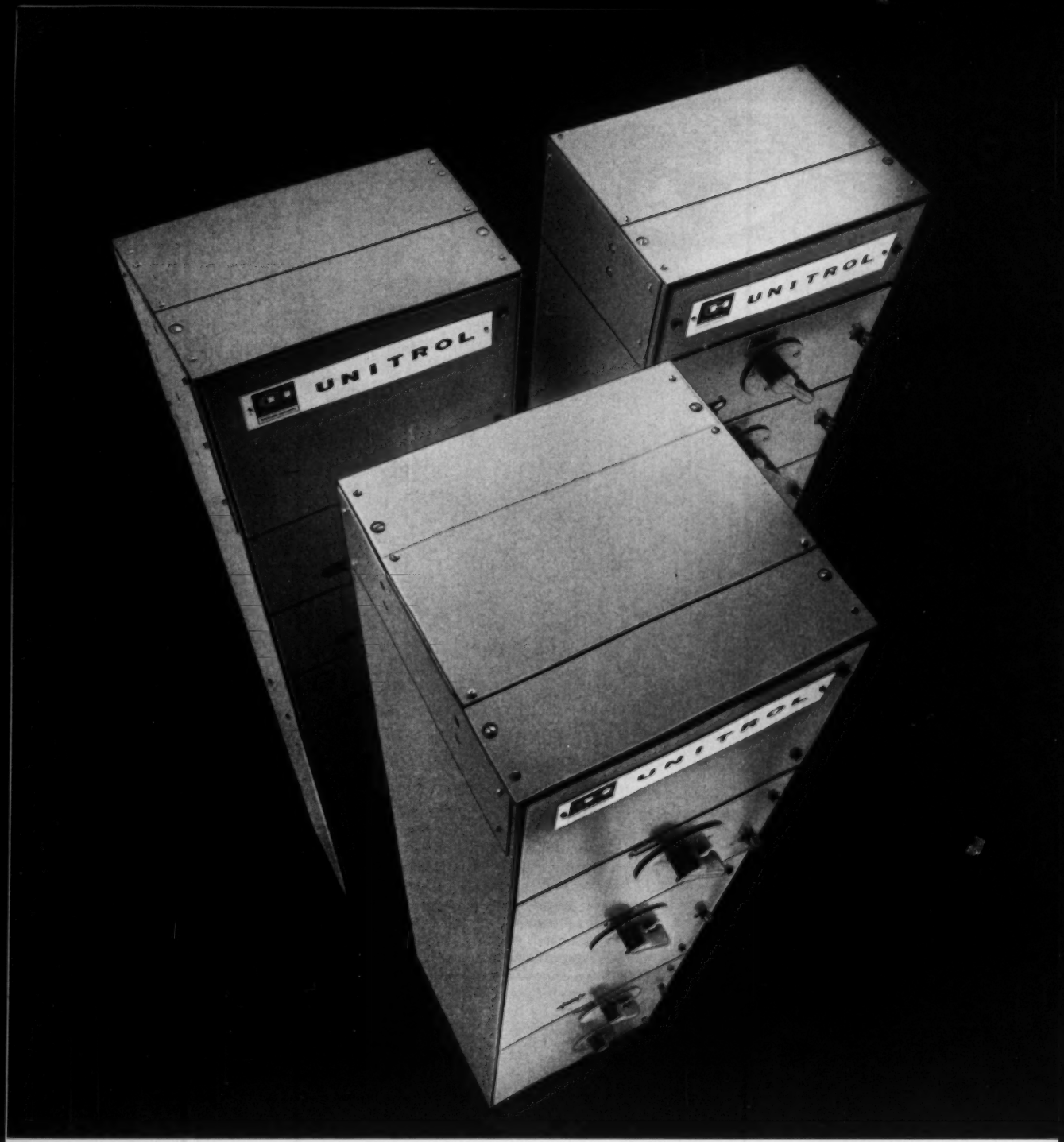
The factory will produce interlocking tiles of the "Chateau" pattern, designed to have a covering capacity of exactly 100 square feet per 100 tiles. The products will be finished in a semi-glaze, similar to that used with success on Australian concrete roofing tiles. In addition, two semiautomatic machines will be installed for the production of special shapes such as ridge, hip, and valley tiles.

The fully automatic plant will consist of a U-shape conveyor system, 70 feet long and 10 feet wide, on which oiled aluminum pallets carrying freshly made tiles will pass through a series of processing machines. Production rate of the system will be 60 tiles per minute. The tiles will be untouched by hand until they are finished and ready for the stockyard; the pallets will never be touched. As a result, the labor content of the tiles can be reckoned at 1/3 manhour per 100 square feet of roof.

Aluminum pallets, traveling along the conveyor in a continuous band at up to 60 per minute, are coated with a suitable parting oil before they enter the tile making machine. Here, a layer of mortar is extruded between the moving pallets and a roller with a patterned surface. The mortar emerges as an unbroken ribbon, shaped to the cross section of a particular design of tile. Further on, a V-shaped knife descends to cut this ribbon into tile lengths with slightly beveled ends. These pass through cabinets in which they are sprayed with liquid cements containing metallic oxide or synthetic pigments to give them a plain or multicolored finish.

If desired, the tiles can then be passed through an automatic granule applicator which gives them a dressing of colored particles, made either from crushed natural minerals or from sand fused with metallic oxide. In the new California plant, however, a granulated surface will not be applied. As the tiles leave the spraying cabinet, parallel belts traveling at different speeds will rotate the tiles through 90 degrees for movement through a second cabinet in which the ends of the tiles will be flashed with matching or complimentary colors.

Next, the tiles and pallets are au-



WHO ELSE BUT CUTLER-HAMMER GIVES YOU ALL THESE FEATURES?

- Quick and safe maintenance
- All front connections
- Tough baked enamel finish
- Completely safe wiring troughs
- Add options . . . no crowding
- Vertical bus silver plated
- Quick latch door fasteners
- Five padlock locations
- 100% interchangeability
- Positive off-power test position
- Modular construction

CONTROL

Now! Cutler-Hammer Unitrol in two new shallow depths!

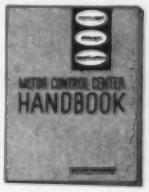
Get more compactness, more flexibility in motor control centers plus Cutler-Hammer dependability and safety

With Unitrol, you eliminate the high cost of mounting and wiring individual starters, as well as using far less space. Unitrol gives you flexibility, too . . . easy to change starters to fit needs and expand without disturbing other starter units. The two new shallow depths (15" and 12") make Unitrol practical even on catwalks or tunnels. Unitrol's modular design lets you put as many as 8 Size 1 starters in a single section and still leave room for many options.

But, probably more important is the safety factor built into Unitrol—safety for the men and machines. For instance, you can *lock* each unit in maintenance position for complete safety. Look at the features at the left for some of the extra values in Unitrol.

What's new at Cutler-Hammer? You can see the new spirit and vitality in a flood of new products and product improvements. Plant capacity has been increased. We've added new engineering talent to increase efficiency. Everywhere you look, you can see that we're ready to help you meet the challenge of the years ahead. Get the inside story from the Cutler-Hammer sales office nearest you.

NEW! FREE! BOOKLET: The "Motor Control Center Handbook" gives you practical facts on selecting the proper control as well as estimating for future needs. Send for Pub. LJ-1-G283 now!



WHAT'S NEW? ASK...

CUTLER-HAMMER

CONTROL

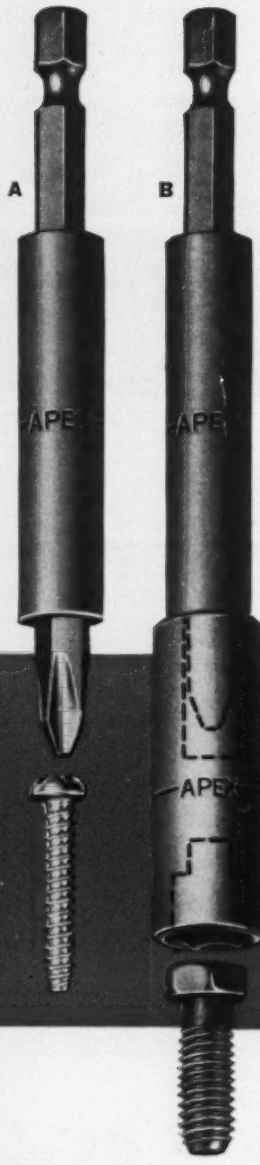
Cutler-Hammer Inc., Milwaukee, Wisconsin • Division: Airborne Instruments Laboratory • Subsidiary: Cutler-Hammer International, C. A. • Associates: Canadian Cutler-Hammer, Ltd.; Cutler-Hammer Mexicana, S. A.

Circle 677 on Page 35

In assembly and fastening work, a tool operator may be driving screws one minute, running nuts the next.

To keep this work moving right along, you could use two power tools, or one power tool equipped with a slip chuck, to interchange bits and sockets.

But the best way to make one tool do two different jobs is to use an Apex socket that slips right on over the bit —in just seconds you're ready to run down nuts and bolts. The socket can be removed just as quickly when it's time to drive screws again. The Apex method makes for better, safer work, too, because there are fewer accessories on the tool and consequently far less wobble and looseness.



This APEX Socket converts a screwdriver into a nut runner ...in seconds!

Apex—the authority on fastening—offers the most complete line of standard and magnetic fastening tools, plus an array of specials that have solved some of the most unusual fastening problems. Write, on your company letterhead please, for

CATALOG 30-A
Nut Running Tools, 1/4" to 5/8" hex, square drives.

CATALOG 30-B
Nut Running Tools, 3/4" to 3 1/2" hex, square drives.

CATALOG 30-C
Screwdriving Tools.

A. Apex M-490 Magnetic Bit Holder, with 1/4" hex shank Apex Insert Bit to drive Phillips screws. Bit holder available in non-magnetic type.

B. Apex WJ-196-F Socket, to run 7/16" hex bolts, nuts. Solid hex shank on insert bit provides firm connection for 1/4" female hex drive on socket. Socket available in magnetic type.

APEX FASTENING TOOLS
SCREWDRIVING • NUT RUNNING • SPECIAL
The APEX Machine & Tool Co. • 1034 So. Patterson Blvd. • Dayton 2, Ohio

tomatically divided into groups of six and delivered sideways to an automatic racking system. Forklift trucks transfer them from the racks to curing rooms where they remain for 24 hours at a controlled temperature of 38C and a humidity of 80 per cent. The tiles and pallets are then returned to the racks and later to the main conveyor system where revolving, disc-shaped knives detach the tiles from the pallets. After separation, a different conveyor delivers the finished tiles to a stockyard or stacks them vertically on their edges, while the pallets return along the main conveyor to be automatically cleaned and oiled ready for a fresh supply of mortar. Automatic racking and curing systems for the new plant will be built by Columbia Machine Inc. of Vancouver, Wash.

Paris, France

Biennial Exposition of Mechanical and Electrical Equipment will be held in the new Palais de la Defense from May 25 to June 2, 1962. Featured will be exhibits of factory production equipment and machinery. Machine tool makers from all parts of the world will also display their products in a concurrent Biennial Machine Tool Show. These events are part of a plan by The Paris Chamber of Commerce to make the City of Light a world center of industrial, trade, and technical conventions.

Brazil, S.A.

A truly "international" order for a remotely-operated slab and bloom marker has been received by M. E. Cunningham Co., Pittsburgh. The machine is being built for a German engineering company, will be installed at a steel mill in Brazil, and the mill will be owned and operated by a Japanese group. The order was placed by Maschinenfabrik SACK, of Dusseldorf. Installation will be made at the Intendente Camara works of Usiminas do Brasil, for which SACK is supplying the slabbing mill and an 80-inch hot strip mill. The bloom marker will have nine 1/2-inch character marking wheels in a stamping head. Positions of the marking wheels, as well as the complete marking cycle, will be controlled by pushbutton from an operator's pulpit.

Circle 678 on Page 35

CLEVELAND TRAMRAIL AUTOMATIC HANDLING SYSTEMS

Long Hauls • Heavy Loads
Big Man-Hour Savings

ROBOT materials handling systems are here. Cleveland Tramrail has a wide variety of them in use in many plants. Some operate inside, some outside; some between machines, departments, or building floors; some between distant plants (as illustrated above). Some carriers travel between two points; others serve as many as 126 stations.

Operators are not needed for robot carriers. Pressing a button sends a carrier on its way. At the delivery point it stops automatically. After unloading and reloading, pressing another button returns it to the original station or to some other station as selected.

Cleveland Tramrail automatic carrier systems are available for loads of 1000 lbs. to 10 tons. They will lift loads to heights of 100 feet, if necessary, and carry them for practically any distance. Some carriers even unload and return automatically.

The man-hour-saving possibilities that Cleveland Tramrail Automatic Handling Systems offer you are tremendous—and there are other important advantages. It will pay you to get acquainted with this rapidly spreading idea of materials handling.

GET THIS SPECIAL REPORT
Write us for your free copy of "AUTOMATIC DISPATCH PORTFOLIO" Gives data on a variety of cost-reducing automatic handling installations.

CLEVELAND TRAMRAIL DIVISION
THE CLEVELAND CRANE & ENGINEERING CO.
1310 East 290th Street, Wickliffe, Ohio

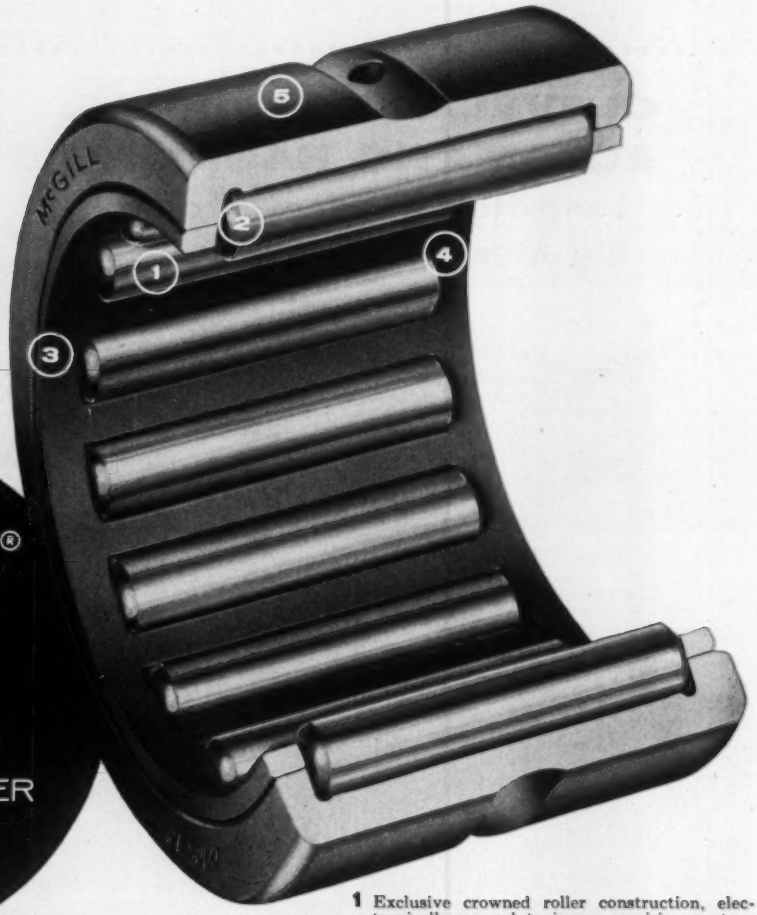
CLEVELAND TRAMRAIL
OVERHEAD MATERIALS HANDLING EQUIPMENT

Circle 679 on Page 35

NEW

CAGEROL®

CAGE TYPE
HEAVY DUTY
NEEDLE ROLLER
BEARING



BY McGILL®

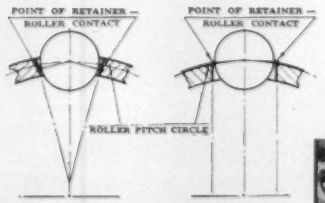
1 Exclusive crowned roller construction, electronically gauged to insure precision contour and size uniformity. Relieved ends assure even load distribution.

2 Flat ends fully engage integral race shoulders, provide maximum support.

3 Proper guidance assured by tapered retainer pockets. The design insures *balanced* roller support and eliminates corner wear from edge loading of straight pockets where retainer OD and pitch circle are coincident.

4 Simultaneously punched pockets assure accuracy of race and roller alignment. The black ferrous oxide retainer finish absorbs and retains lubrication, reducing the friction coefficient.

5 SAE 52100 steel outer race has optimum hardness and surface finish.



INCREASE EXPECTED LIFE UP TO 10 TIMES!

You need CAGEROL bearing performance if higher speeds and increased misalignment have prevented the utilization of needle bearing load capacity in your applications. Most important, CAGEROL bearings can deliver up to 10 times more expected life where misalignment and increased speeds exceed the capabilities of ordinary and guided needle bearings. The difference is in the exclusive McGill construction that features tapered retainer pockets for balanced roller guidance, crowned rollers, and black oxide retainer finish. CAGEROL bearings are interchangeable with all heavy duty needle roller bearings — with or without inners in two bore sizes.

Ask for Bearing Catalog #52-A.

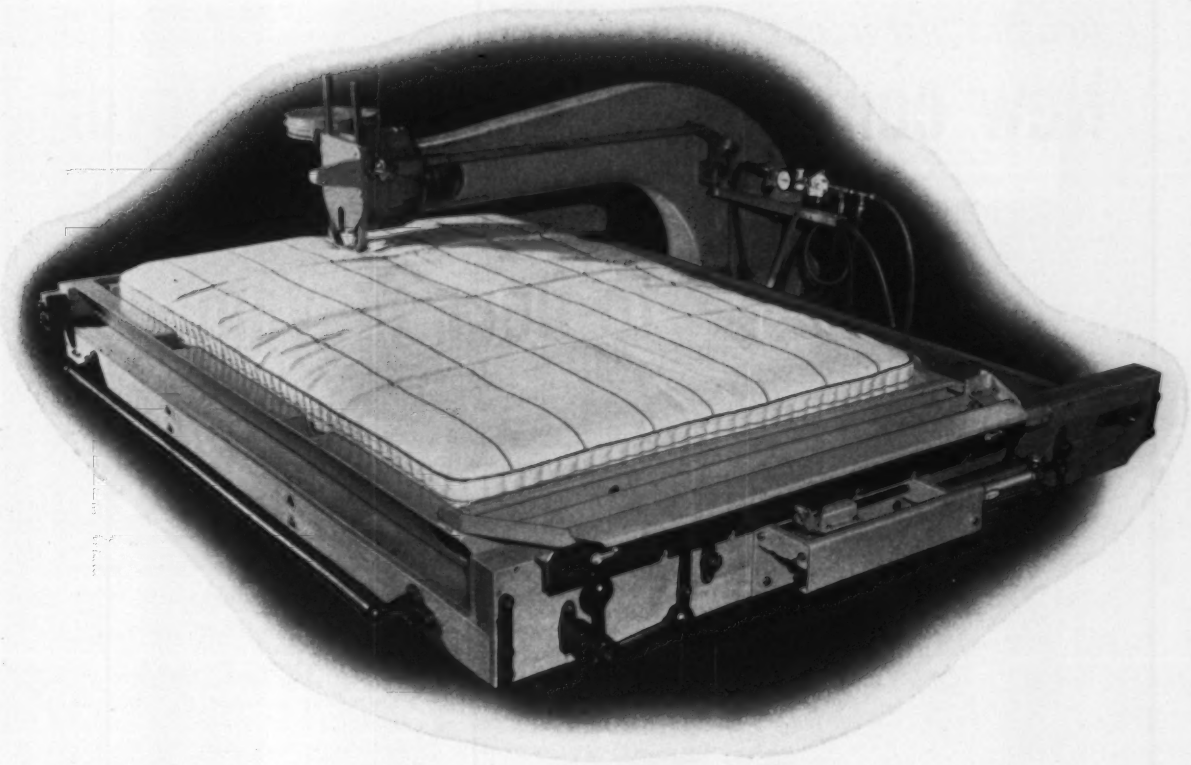
McGILL MANUFACTURING CO., INC., Bearing Division
401 N. Lafayette Street, Valparaiso, Indiana

engineered electrical products

McGILL®

precision needle roller bearings

Circle 680 on Page 35



You sleep better at night with Controlled-Air-Power on the job

Whether you build "mattress tufting machines," like the one illustrated made by Matherson Mattress Machine Co., or make any of the thousands and thousands of different products produced by American industry, there is a place for Bellows-Valvair pneumatic devices—in your plant and in your product.

In your plant, Bellows-Valvair pneumatic devices can turn outmoded equipment into real profit makers; can form the heart of toolroom-built special purpose machines; can cut the costs of scores of operations.

In your product, these ingenious units can simplify design by replacing levers, cams, gears or mechanical linkages, with fast, smooth, air-powered push, pull, lift or turn motions . . . cut design and manufacturing costs, streamline appearance, improve product performance.

No matter what you make, or how you make it, you'll sleep better at night with "Controlled-Air-Power" on the job.

Talk to a Bellows-Valvair Field Engineer.
You'll enjoy it. Phone him—he's in the book.

Bellows-Valvair
AKRON 9, OHIO
DIVISION OF INTERNATIONAL BASIC ECONOMY CORPORATION (IBEC)

1005-C

Circle 681 on Page 35

Another first from Standard Conveyor

New continuous vertical conveyor revolutionizes floor-to-floor movement

Escaveyor self-loads, self-unloads, lifts products straight up or down without tipping or jarring. Provides smooth up, down, or reversible service.*

How Escaveyor speeds production. Here is the answer to your big need for a fast, continuous flow of commodities from floor to floor. Escaveyor moves commodities at a steady rate of 8 to 10 loads per minute.

How Escaveyor saves space. Escaveyor lifts packaged or unit commodities rapidly from floor to floor with the continuity of a belt conveyor. Yet your product always rides level. And look at the huge saving in space! It takes even less floor space than a conventional monostrand or straight-lift conveyor! Escaveyor's size is tailored to fit your package.

How Escaveyor costs less. Escaveyor actually costs less to purchase and install than practically any other type of lift. It requires less manpower because no manual loading or unloading is required. You also save many square feet of valuable floor space.

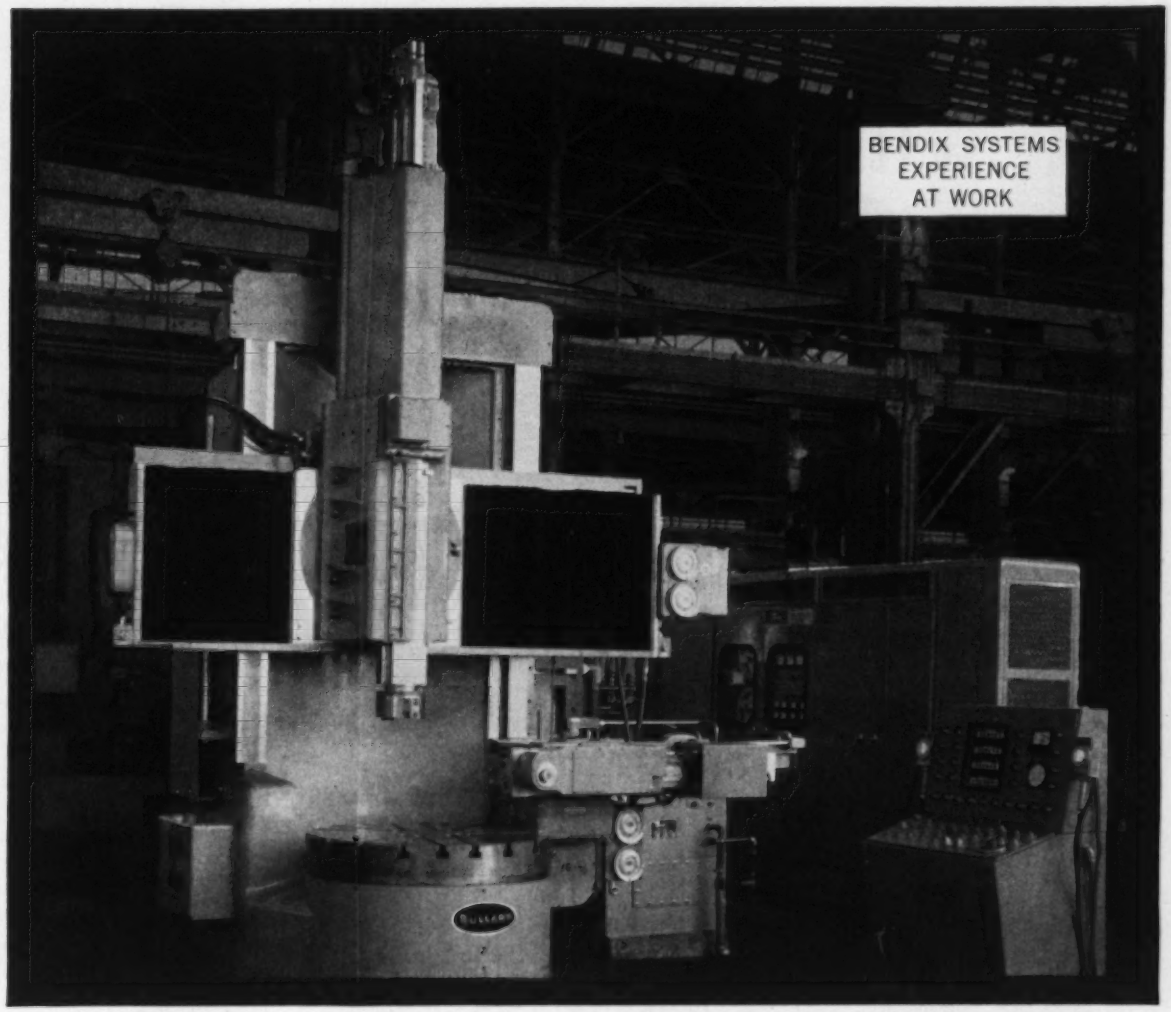
Free brochure. Send for free Escaveyor brochure! It tells how Escaveyor works, and how it can solve vertical material handling problems for *you!* Get your copy from Standard Conveyor Company, Dept. 303-D, North St. Paul 9, Minnesota, or from your nearby Standard Conveyor sales representative.

*patent pending

Standard Conveyor

Sales and Service in over 40 Cities
Consult your Yellow Pages

Circle 682 on Page 35



BENDIX SYSTEM ENGINEERING PROVIDES OPTIMUM NUMERICAL CONTROL FOR TURRET LATHE

Shown above is a Bullard four-axis vertical turret lathe equipped with Bendix DynaPath-14 contouring control unit. In this application, the selection of tools and spindle speeds is programmed, as is the motion of both slides.

Bendix application engineers, with accumulated experience in mechanical and hydraulic analysis of machine tools, worked closely with Bullard to produce this wedding of machine tool and numerical controls. And Bendix systems experience gained in working on other contour turning applications (with such companies as Ex-Cell-O, Heald, and Giddings & Lewis) assures the user correct application of control unit to machine tool.

In addition to contour turning applications, Bendix engineers numerical control systems for milling, grinding, drilling and jig boring machines. We have developed and applied controls to 2-, 3-, 4-, and 5-axis systems, both continuous path and point-to-point. These controls are being used daily in plants across the country to increase machine tool efficiency, reduce lead times, and make parts of consistently high accuracy.

Bendix SYSTEMS EXPERIENCE can provide the key to your machine tool problems. The right Bendix numerical control unit can be the profit-maker you've been looking for. Start putting Bendix application engineering experience to work for *you*—write today for a copy of our catalog number 308.

BENDIX PROVIDES SYSTEMS EXPERIENCE

JUSTIFICATION STUDIES • SYSTEM ENGINEERING • TRAINING AND SERVICE

Industrial Controls Section

21820 Wyoming Ave., Detroit 37, Michigan

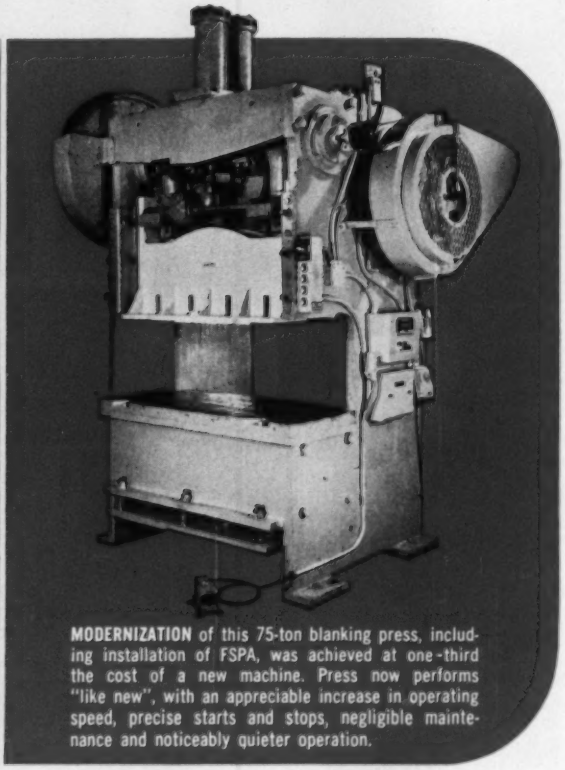
THE Bendix CORPORATION

Circle 683 on Page 35

DESIGN or MODERNIZE POWER PRESSES

...with Fawick FSPA

ADVANCED DESIGN of this new press incorporates Fawick Standardized Press Application to insure high-efficiency clutch and brake service needed for machine's 300-stroke-per-minute operating speed. Built by Precision Welder and Flexopress Corp., Cincinnati, the 100-ton press stamps hermetic motor parts 2½ times faster than was previously possible.



MODERNIZATION of this 75-ton blanking press, including installation of FSPA, was achieved at one-third the cost of a new machine. Press now performs "like new", with an appreciable increase in operating speed, precise starts and stops, negligible maintenance and noticeably quieter operation.

... for *high-speed production with precise control*

The FAWICK Standardized Press Application provides the superior air clutch and brake performance needed to gain faster, more precise operation of power presses and other cyclic machines.

For original equipment or for modernization, FSPA helps you fight rising costs. It provides simple, economical installation with wide flexibility of application. Instant air clutch action insures fast, accurate cycling, with unmatched low maintenance and positive safety. Tools and dies are protected through elimination of backlash.

The FSPA package incorporates the dependable FAWICK CB Airflex Clutch, self-energizing CS Brake, Timing Rotorseal and high-speed clutch controls. Standard units are produced for crankshaft mounting on presses in the 5 to 150-ton range. Other conversion units are available for presses up to 2000 tons capacity.

For engineering information call your nearest FAWICK representative or the Home Office.

you can apply FSPA on new or used:

- geared presses
- non-geared presses
- press brakes
- press feeders
- shears
- cut-off machines
- benders
- formers
- forging machines
- seamers
- upsetters

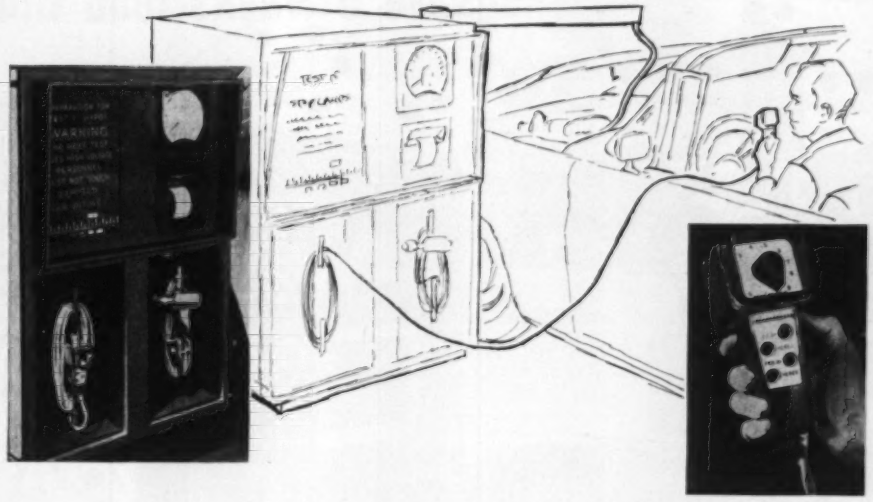
FAWICK AIRFLEX DIVISION
FAWICK CORPORATION
9919 CLINTON ROAD • CLEVELAND 11, OHIO
Fawick Canada, Ltd., 60 Front St., West, Toronto, Ont., Canada

FAWICK AIRFLEX

INDUSTRIAL CLUTCHES AND BRAKES

Circle 684 on Page 35

By LEE D. MILLER, Associate Editor



Automobile electrical system is checked out with equipment which simultaneously gives the inspector instructions and sets up internal test circuits as required. Instructions for the inspector are projected on screen at left of test unit (left inset). The inspector controls the test cycle and records evaluations by use of a switch unit (right inset) while he sits in the automobile.

Checking Out

AFTER carrying the Detroit Dateline banner for more than five years, Jim Keebler is checking out of this assignment. As thorough readers of AUTOMATION know, Jim assumed additional broad duties on January 1 when he became Editor of this magazine. Recognizing the added demands of his new position, he has passed along this banner which he enjoyed carrying.

But the transition should not be a loss to AUTOMATION readers. Jim will now be able to carry even more vigorously the other banners under which he serves the interests of those desiring information and insight on the automation world. And comments on the automation scene will still flow from his pen each month through the medium of his editorials.

Seen on the Screen

In some respects this particular act of checking out is similar to the countless checking out operations that are performed every day to produce automotive products of desired quality. Such checkouts are a prelude to the period of bigger and better service which is expected to follow.

Checkout operations in the automotive production cycle have been receiving more and more attention with an eye toward automation of routine phases of the function. The thinking seems to be—why shouldn't the advantages of automatic techniques be applied to checking just as much as to making—or even more?

Such thoughts are obviously taken seriously at Ford. For example, electrical systems on Lincoln Continentals are checked out on equipment dubbed EAGER for electronic audit gager. After final assembly of an automobile, the electrical system is checked in accordance with a program recorded on 35 mm film.

The electrical system can be checked against specified standards and a permanent record of results printed on tape in 15 minutes of inspection time by use of the equipment. This represents a sizable reduction from the 2 hours previously required for the same battery of tests. And the checkout is so consistently reliable that this procedure is credited as an important factor in Lincoln Continental's announcement of a 24-month warranty period.

Each frame of the film strip used in the EAGER carries information in two prescribed areas of the frame. One area contains printed instructions which are projected on a translucent screen to guide the inspector. The second area of each film frame is coded to allow projector light to reach only selected units in an array of photocells. The photocells in the control system automatically set up internal test circuits required to make the test called for by that frame of the film.

While Seated at the Wheel

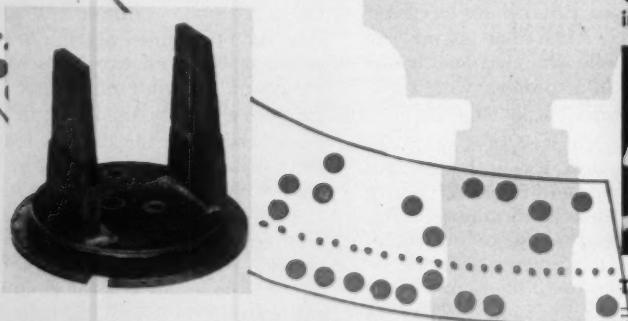
Five test leads from a folding arm connect the test equipment to the automobile—positive and negative battery cable, distributor terminal of coil, and two leads to the temperature sensing unit. After connections are made, the inspector conducts tests from the driver's seat of the automobile using a remote switch unit which he holds in his hand.

Basic instrument for display of test results to the inspector is a voltmeter with appropriate shunts switched in and out of the circuit by the control system. The voltmeter has a lighted bar scale readout which is projected on the screen. Information projected from the film includes the superimposing of acceptable

REDUCE TOOL COSTS $3000

save 5 weeks lead time

Burgmaster Model 2BHT 6-Spindle Turret Drilling, Tapping and Boring Machine equipped with Hughes 2-Axis Numerical Controls. X-Y axis controls table motion and machining of holes in flat plane. In this setup, a third motion controls the rotary fixture to automatically machine all radial holes. This is accomplished by a switching device on the Control Panel converting "Y" information to rotary information.



Rocket Bulk Head is completely drilled, countersunk and tapped on Burgmaster Tape Controlled Turret Drill without jigs or drill bushings. 16 tools are used to machine 69 holes.

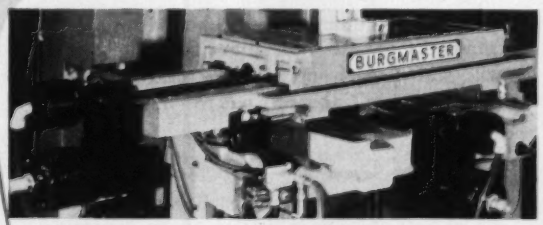


Table Servo-Motors position table at 180 in./min. within ±.0005", repeatable to ±.0002", non-cumulative. Each axis of table motion is equipped with heavily pre-loaded ball bearing lead screws and anti-backlash ball nuts. Automatic clamps lock table into a rigid unit during machining.

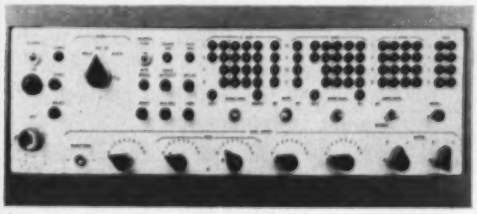
ON ROCKET PART

at Hughes Aircraft Company

Hughes Aircraft, Tucson, Arizona, use a Burgmaster 6-Spindle Turret Drilling, Tapping and Boring Machine equipped with 2-axis Tape Controls for controlling X, Y, and rotary motions to materially streamline production of small lots. Typical savings are shown in drilling, countersinking and tapping 69 holes in a lot of 50 cast iron Rocket Bulk Heads. Due to the fully automatic action of the tape controlled Burgmaster Turret Drill, expensive jigs and fixtures are eliminated — reducing tool costs $3000 — while saving 5 weeks lead time getting the job into production.

This is maximum flexible automation. Fully automatic machining is carried out in accordance with the commands of an easy-to-prepare tape performing any combination of six operations without tool changing. Individual preselective spindle speeds and feeds assure each operation is done at optimum tool efficiency for fine finish, precision, speed and long tool life. Engineering changes involving revision of machining can be done quickly by simple tape modification.

BURGMASTER



Hughes 2-Axis Tape Control Panel mounted at eye level on the Control Cabinet is provided with display lights that show accuracy of programming at a glance. This 2-axis system automatically controls positioning of the Burgmaster machine table on the X-Y axis simultaneously and directs the "third" axis when needed. A third axis of control may be added to the system to govern individual spindle depths, thus eliminating manual setting of the standard machine depth stops; or control special indexing fixtures with ±0° 03′ for automatic location and machining of radial holes, etc. Operator can dial dimensional commands directly into panel for any axis.

Job Facts

Company: Hughes Aircraft Company, Tucson, Arizond

Machine: Burgmaster Model 2BHT-L 6-Spindle Turret Drilling, Tapping and Moring Machine equipped with Hughes 2-Axis Numerical Controls.

Part: Cast Iron Rocket Bulk Head.

Quantity: 50 parts.

Holding: Flat Plane Holes — Simple Adapter Plate; Radial Holes — Special Vertical Rotary Fixture controlled by "Z" axis.

Accuracy: Flat Plane Holes — ±.0005" hole centers; Radial Holes— ±0° 03′

Savings: $3000 tool costs; 5 weeks lead time.

Other Advantages: Fewer rejects due to elimination of human factor; less inspection; reduced floor space required; much faster engineering changes; economical production of small lots; less tool changing; less work movement.

ALL LEADING STANDARD MAKES of Numerical Controls are available in Burgmaster Tape Controlled Turret Drills at Customer's preference. Write for literature describing 6 and 8 spindle machines with complete specifications and features. Twenty minute 16mm sound film showing Burgmaster turret drills in operations, including, the new automatic positioning table, available from any office.

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Plus dealer representatives in other industrial centers.

Circle 685 on Page 35

measurement limits on the scale of the voltmeter.

Comparing the test result to the prescribed limits, the inspector decides whether the circuit or component under test should be accepted or rejected. He pushes an appropriate button on his remote switch unit to record his evaluation on a printed output tape. The machine automatically records the test identification beside the inspector's decision. The operator can also specify various reasons for rejection and have them recorded by code number.

When a given test is completed, the inspector presses another button to advance the film strip one frame in the projector. The succeeding tests can then be similarly executed.

Use of a film projector to simultaneously give instructions to an operator and a piece of equipment is not limited to this specific application, of course. Performance Measurements Co., builder of EAGER, foresees direct uses in checking a wide variety of units in appliance, radio, television, aircraft, missile, and ordnance systems.

For even more automatic cycles they are already building newer equipment for checking automotive electrical systems. These units automatically cycle through tests and automatically evaluate test results against the specified performance limits.

As nearly anyone would expect, other automakers have also been thinking of automatic ways to do their checking jobs. One of the interesting developments by General Motors Research Laboratories was named the Sealector. This automated inspector checks lip seals used to retain lubricants in automobile wheel bearings, rear axles, and transmissions.

Need for a reliable 100 per cent inspector is strengthened by results of a two-year GM study of quality control specifications of seals. GM engineers found that a lip seal should be a precision assembly, not just a piece of flexible material for plugging a hole around a rotating shaft.

In the Sealector, each seal is automatically fed and checked to see whether or not it meets the standards fixed by the engineers. The checking equipment is basically an air leakage measuring device with a flowmeter connected to a regulated air supply and an electronic control system.

Each seal is clamped at the open end of a cylindrical cavity containing a two-diameter stub shaft. With the seal in place and the smaller diameter of the stub shaft extending through the seal, ½-psi air pressure is applied to the cavity. If there is no air leakage, the seal is too small. If the flowmeter reports that some air escapes, the stub shaft is advanced until its larger diameter is in the seal. If air continues to escape, the seal is oversize, eccentric, or both. If the flow stops, the seal is within tolerance.

Backed up by the automated seal checker, GM engineers are able to fix seal standards where none existed previously. Quality control is reported improved not only by maintaining diameter tolerances, but also by rejecting seals with eccentric shapes, faulty bonds, or missing springs.

Operator loads lip seals into automatic machine for 100 per cent inspection. Seals are automatically fed through the equipment and air tested for proper fit and lip pressure against a two-diameter stub shaft. Test with the small diameter detects seals that are too small; test with the large diameter spots eccentric or oversize seals.

Shift in Lineup

Besides the companies specializing in checkout equipment and the companies developing such equipment for their own use, companies in related fields are developing new approaches in the checkout area. Bendix Corp. recently organized a special section of the corporation to design, build, and market such support equipment as a separate product line.

They showed automatic test units for the first time at the recent International Exposition of Automotive Engineering at Cobo Hall. One of the test stands displayed performs nine different tests automatically on a power steering valve in 15 seconds. To perform the same tests manually requires 15 minutes.

Bendix moves into the general test equipment field on the basis of many years of designing and building support equipment for use with products they manufactured. Now their engineers explain that the increase in automobile warranty periods and the emphasis on quality and reliability of components have made precise, complete inspection even more important than it has been. They expect to design equipment to meet the increased demands for accurate and fast checking operations.

Help Wanted

Since the world of automotive manufacture is spread over an extremely wide spectrum, many interesting developments are never reported—not because of company policy, but simply because the word doesn't happen to get passed. It is therefore the announced policy of this column to invite any and all readers to submit news or views on things automatic in automotive production. Your participation will be welcome.

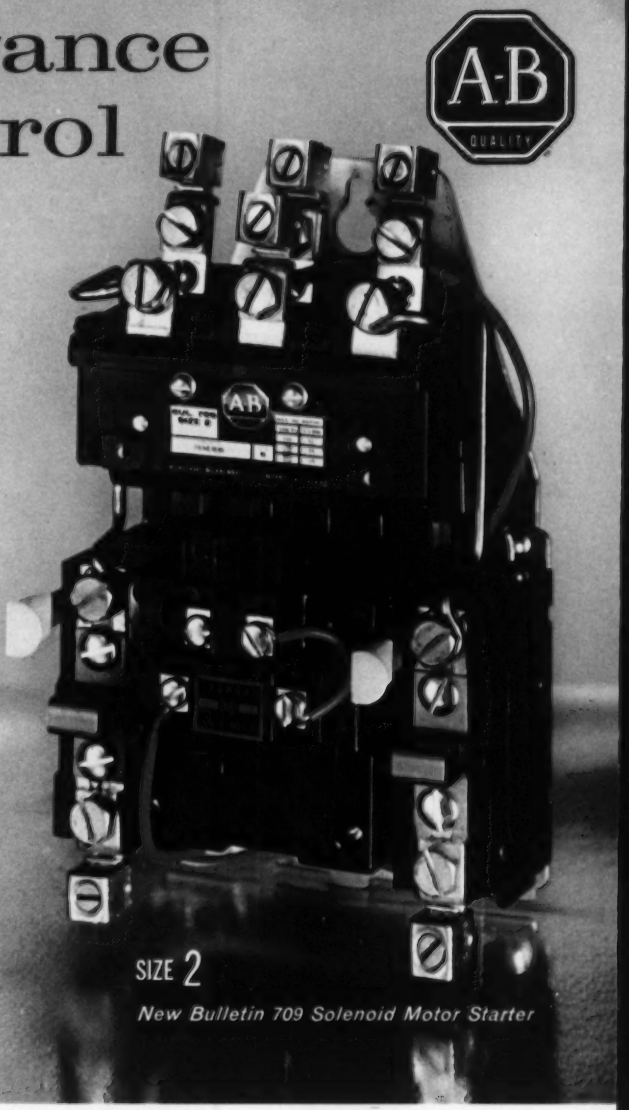
Circle 686 on Page 35→

a new line of Bulletin 709 motor starters by ALLEN-BRADLEY

- smaller size
- greater interrupting capacity
- even more millions of trouble free operations
- more wiring room
- elegant styling
- A-B "quality" throughout

A "family" of 7 starter sizes ... each one entirely new

greatest advance in motor control in 30 years



In appearance . . . in performance . . . in physical size and weight . . . these Allen-Bradley Bulletin 709 solenoid starters are *completely new in every way!*

NEW COMPACTNESS. Size reductions are so drastic you'll hardly believe your eyes. The tables below will give you some idea of how the new line of Bulletin 709 starters compares with the old.

A TREMENDOUS INCREASE IN LIFE—both mechanical and electrical. All of these new starters are good for many more millions of trouble free operations.

NEW PATENTED MAGNET. For its weight and size, the most powerful magnet used on motor control. Its short, cushioned stroke assures long contact life. A new, permanent air gap prevents any possibility of magnetic sticking. "Snap action" guarantees positive contact opening and closing.

NEW MOLDED COIL. Impervious to atmospheres that could cause trouble, and also protected against mechanical damage. All coils are easily removed—from the front of the starter.

NEW CONTACTS. New double break contacts of cadmium oxide silver resist welding . . . close and seat firmly without sliding or wear-causing motion.

NEW OVERLOAD RELAYS. Not only "trip-free" but also "tamperproof," to reliably protect motor and machines. Of course the new relays were designed to use the old Bulletin 709 heating elements which you have in stock.

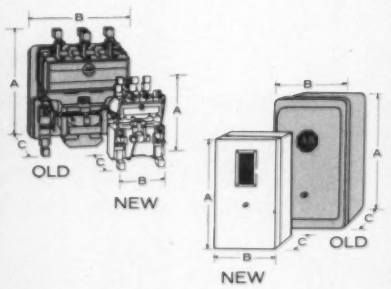
NEW ENCLOSURES. Completely restyled by Brooks Stevens—and so modern. They are a sales asset on any type of modern machine or industrial installation.

BETTER WRITE FOR MORE INFORMATION ON THIS REVOLUTIONARY NEW BULLETIN 709 STARTER!

CHECK THE "NEW" WITH THE "OLD" BULLETIN 709 DIMENSIONS

The wiring room in the new enclosures will delight the electrician.

Starter Size	OPEN TYPE STARTERS					
	NEW			OLD		
	Height A	Width B	Depth C	Height A	Width B	Depth C
00	3⅝	3⅞	3⁹⁄₁₆	—	—	—
0	5⅞	4¹⁄₁₆	3¹¹⁄₁₆	5⅝	4¾	3¼
1	6⅝	4½	3¹¹⁄₁₆	5⅞	5	3¼
2	7¾	4⅝	3¹¹⁄₁₆	10¹⁄₁₆	5¾	4⅞
3	10¼	6¼	5⅞	12⅝	7¼	5⅞
4	11⅞	7¹⁄₁₆	6¼	16¼	12¾	6¹³⁄₁₆
5	14¹³⁄₁₆	9	6½	20	16⅛	8¾



Starter Size	NEMA 1 ENCLOSURES					
	NEW			OLD		
	Height A	Width B	Depth C	Height A	Width B	Depth C
00	7⅝	4⅞	4¼	—	—	—
0	9⅛	6¹⁄₁₆	4⅜	7⅞	5⅜	4¼
1	10	6¹³⁄₁₆	4⅜	8¹³⁄₁₆	6⅜	4¼
2	12	7⅝	4⅜	14½	9	5⅞
3	16⅝	10⅜	7	19½	11⅜	6¹¹⁄₁₆
4	22	11⅝	8	26⅛	14³⁄₁₆	7¹¹⁄₁₆
5	32³⁄₁₆	17³⁄₁₆	9⅞	41½	19³⁄₁₆	13⅜

B-61-RM

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Quality Motor Control

Allen-Bradley Co., 1316 S. Second St., Milwaukee 4, Wisconsin

Come and Get It

One of the greatest challenges of the age of automation is the pursuit of education. Responsible counselors in all fields are advising the youth of the day to be aware of a continuing need for further education to match the changing needs of a culture spurred by rapidly developing technology. The citizens of tomorrow may find it commonplace to learn several professions in a lifetime. Workers must prepare for new occupations and be ready to move to other centers of activity if they are to participate in the prosperity of tomorrow.

The admonishment, "It's what you learn after you know it all that counts," sums up the problem succinctly. No longer can one expect to become educated and then go out to make his way in the world. This is the age of the everhungry student who must continually pursue an educational fare in order to obtain sustenance in an automating world.

The editorial purpose of this journal is to provide top management and manufacturing engineers with a balanced curriculum of adult education in the field of automatic manufacturing operations. The Post Office Department regularly serves it to the readers. This diet is supplemented by an annual Conference on Manufacturing Automation held at Purdue University.

Here is an opportunity to exchange ideas with outstanding authorities selected to present papers, and a chance to discuss common problems with manufacturing men from many industries. The Conference convenes on April 17. Take full advantage. Come and get it.

James C. Keebler

EDITOR

LEGAL IMPLICATIONS OF COMPUTER USE

By ROY N. FREED
Attorney
Ballard, Spahr, Andrews & Ingersoll
Philadelphia, Pa.

The author initially became interested in data processing several years ago as a result of developing new techniques to correlate a mass of evidence for an involved antitrust suit. This interest has led to his serving on the American Bar Association Committee on Electronic Data Retrieval. It is with this background that he reviews the legal aspects of computer usage. Among the interesting points he raises is the possibility that in the future a company might incur liabilities because a computer has not been used.

BECAUSE the consequences of computer adoption are so pervasive, the variety of legal questions that they raise run the gamut of the law. They include, for example, such diverse facets as tort liability involving persons and property, contracts, labor relations, corporations, taxes, patents, and antitrust. In most cases, computer use raises the same types of legal questions as in other areas of experience. Existing rules and apt analogies provide sufficient guidance for their solution. However, there are some unique legal implications to computer use, along with the relative novelty of computers, that suggest the entire subject might well be reviewed to obtain the proper perspective. Alerted to the various legal aspects, most of which are highly technical, computer users will know when to call on their lawyers for advice.

Potential Liability

Our dynamic society tends to make abundant use of technological developments and, thus, creates a constantly evolving pattern of normal and, hence, reasonable behavior. The question whether a computer should be utilized in a specific situation may have legal ramifications as important as the economic factors usually of primary concern. Situations will become increasingly common where a failure to follow the example of others in adopting such a device actually will expose a person or corporation to legal liability, because it will constitute a breach of the obligation to exercise reasonable care.

Two examples point up such potential liability, one involving the corporate officer in relation to his stockholders and the other the user or maker of a device as regards persons harmed by it. Both primary parties have the familiar duty to exercise the care of a reasonable man, although the areas of their activities are quite distinct.

In the first case, assume that most corporations in an industry, or engaging in a particular activity, are using computers profitably to perform significant operations. In such a group, the management of a laggard corporation which adhered to antiquated methods with a resulting loss to the corporation, might be exposed to suit by the stockholders on the ground of mismanagement. The critical question would be, "Has it become normal and reasonable for managers in such a situation to adopt computers?"

Of course, a foolhardy pioneering venture into computer use to which loss can be attributed also might warrant a suit for mismanagement. How-

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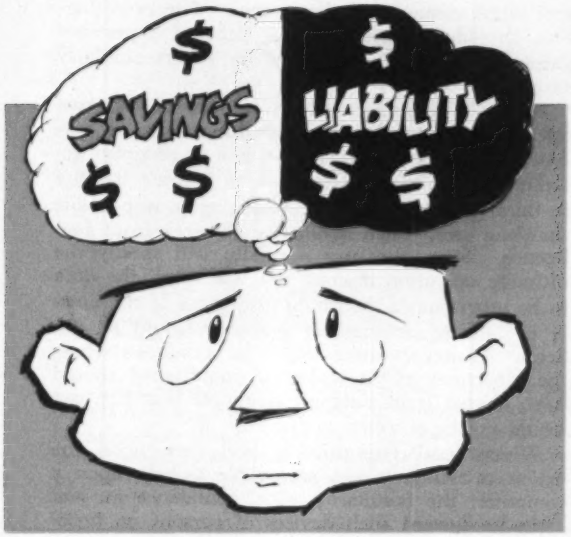


. . . The question whether a computer should be utilized in a specific situation may have legal ramifications as important as the economic factors usually of primary concern . . .

ever, such an act would have to be quite flagrant to represent a real danger.

Consider, similarly, the situation of a railroad that has followed a trend to single track operation to minimize both local property taxes and the cost of maintaining its right of way. However, it retains manual train switching and signaling long after others have delegated that duty to computers with a very good safety record. In the event of a wreck that a sophisticated computer, but not a person, could have avoided, the railroad might find itself liable because of its failure to keep pace with technology. For a discussion of the analogous failure by a ship operator to utilize radar, see Healy, *The Legal Effect of Radar in Marine Collisions*, 17 Fed. Bar J. 597 (1957).

The same rationale might be applicable in the area of manufacturer's liability. Advance computer testing of a complex product by simulating its operation, might avoid failure in the hands of a user and resulting harm to persons and property.

These "due care" situations, which might also involve identical considerations where computer use as well as nonuse is concerned, can be quite troublesome. They are almost universally fact questions for jury decision, without the assistance of expert testimony specifically directed to the issue of reasonableness. For some time to come, the extent of and experience with computer use for a particular purpose may be so unknown to the ordinary juryman that he is unqualified to pass judgment, relying solely on his own knowledge, on the due care involved either in a use or failure to use.

As the wizardry of computers continues to be discussed publicly, the confidence of laymen in them will increase, and the obligation to utilize them will expand commensurately. Since this obligation is related directly to the extent to which others have adopted the devices, it is not a static condition, but may come into existence at any point of time. Consequently, persons concerned with minimizing legal liability must scrutinize industry practices continuously from this point of view.

Liability in Utilizing Computers

Generally, the utilization of a computer, regardless of whether it is operated by the user or by someone else, does not create legal problems but merely varies the severity of those problems that stem from other causes. Computer use might reduce the likelihood of legal liability under certain circumstances, as well as increase it under others. And the actual effect in the same fact situation in the event of litigation could fall anywhere between either extreme, depending upon the knowledge of the court or jury of the mechanisms and qualities of computers. This is so because the propriety of computer use generally is a pure fact question. Probably, the nature of the legal effects of resorting to a computer can be comprehended best from some concrete examples.

In the example already given of reliance upon a computer to control railroad use of a single track system, the machine well might be substantially less fallible than the personnel who would serve as alternatives. Hence, computer use might minimize the occurrence of collisions of trains with one another, and thus, reduce legal liability.

On the other hand, a delegation of decision-making responsibilities to a computer might increase legal liability, where a resulting harmful consequence probably would have been avoided by a reasonably competent person who ordinarily would have been assigned to the task. Assume the situation of a medical diagnosis made by a computer on the basis of only a portion of the symptoms and used as the basis for incorrect and injurious treatment by an auxiliary medical employee, all without the intervention of a doctor.

Either a diminution or enlargement of liability would be possible where a computer is used to simu-

. . . the management of a laggard corporation which adhered to antiquated methods with a resulting loss to the corporation, might be exposed to suit by the stockholders on the ground of mismanagement . . .

late in advance of manufacture the functioning of a complex product, such as a jet airplane designed to fly at high altitudes and great speeds. Careful programming and processing of relevant data might anticipate structural defects and prevent the occurrence of serious accidents from the use of a faulty design. Or quite the reverse might occur. Erroneous programming or feeding of data to the computer might create just such a catastrophe, because of misplaced confidence in the infallibility of such a device and a consequent failure to utilize operational test procedures.

What Is Reasonable?

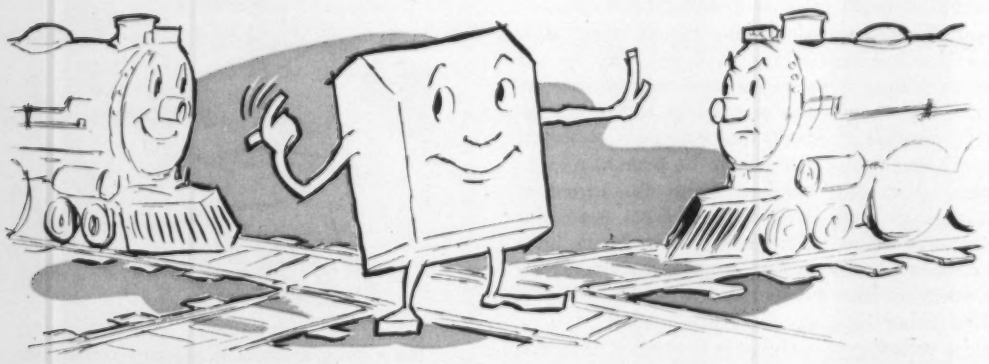
As previously mentioned, the question of the exercise of reasonable care in the utilization of a computer has many special facets that stem from the peculiar nature of the devices. Included among them are the especial need for continual re-evaluation of how the device is being utilized, and the significance of general community attitudes toward such devices.

Where computers are utilized, the existence of reasonable care probably should be judged as of two points in time: When the program and control criteria were established, which may have been considerably prior to an accident, and also at about the time of the occurrence. Hence, the jury would consider whether reasonable foresight was exercised, in setting up the machine and especially the program, to anticipate and provide for the circumstances that eventuated. Initial program and other determinations may prove to have been faulty. The jury would also consider whether there was any culpable failure to re-examine and revise the earlier decisions, prior to the event, because of developments in the interim. A person relying on computers for control or decision-making purposes may have a substantial obligation, as a practical matter, to conduct a continual re-evaluation of the guiding and input elements of the system. The re-evaluation should be made in the light of experience gained both by the user and by others similarly situated.

Where a computer utilized for control purposes fails to fulfill its role with resulting harm to persons or property, the manufacturer or program designer might find itself exposed to maker's liability to third persons, if it is financially more responsible than the user. Such liability might arise from negligence. Since the user normally will specify the ultimate operation desired and will select the data to be programmed, ascribing negligence to the maker or outside programmer probably would be difficult. However, there might be situations where the expertness of the maker or programmer should have alerted it to inherent weakness that the user would not be expected to discern.

Where legal responsibility will turn upon the extent to which it was reasonable to rely upon a computer, the familiarity with, confidence in, and attitudes toward such devices of persons on juries will influence the imposition of liability subtly, but substantially, in litigation. Those factors must be considered at different points of time.

In the first place, the variety of human reactions toward computers must be taken into account in selecting veniremen for a jury. Little sympathy for a computer user would be expected from a person who feels that computers are bad because they displace people, cause unemployment, or introduce unnecessary mechanization and dehumanize work. On the other hand, the opposite reaction would be expected from a person who is intrigued by the technological wizardry of computers, considers them beneficial to society because they can perform operations which people cannot, or approves of them because they eliminate routine tasks and drudgery and make possible the upgrading of labor to more interesting and rewarding responsibilities. The existence of particular reactions will depend upon such factors as the employment history, intelligence, education, philosophy toward work, and age of each person, and also the general economic situation in the area, viz., whether or not there is full employment.



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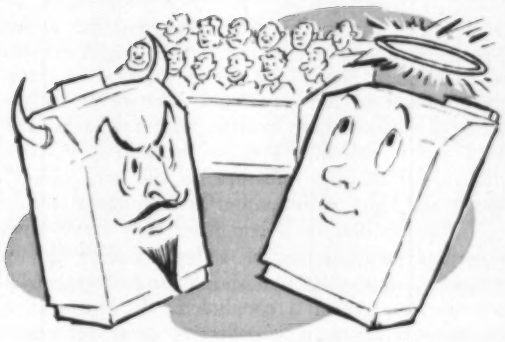


. . . Little sympathy for a computer user would be expected from a (juror) who feels that computers are bad because they displace people . . . the opposite reaction would be expected from a (juror) who is intrigued by the technological wizardry of computers . . .

Then, in trying to convince a jury that the design of a machine control system satisfied the demands of reasonable care, it may be necessary to furnish a fairly detailed description of the mechanism, until general familiarity with and confidence in such devices increases.

Finally, it might be advisable for computer users to take advantage of all opportunities for favorable public relations projects in this field. In addition to the positive factors of computer use listed immediately above, others undoubtedly can be developed and publicized, including the growing importance of resorting to machines for processing transactions, such as check cashings, where the volume has become so great that previous methods are not only unduly costly, but are becoming entirely impractical. Because of the novelty of computers, reports on their uses are considered newsworthy, and publications have been devoting considerable space to such stories.

Special Situations

The effect of contemplated computer use on legal liability should be studied to determine what precautionary action is appropriate to mitigate any potential increase in risk exposure. Take, for example, the case where liability attaches from a failure to correct a hazardous situation within a reasonable time after the receipt of notice, and a computer system is adopted to inspect for such hazards. The device will create such notices so invariably that commensurately infallible procedures should be set up to insure prompt remedial action.

There are various specialized areas of the law in which computer use also may entail liability. For example, the use of the same program by a number of competitors might be considered to violate the antitrust laws, if the result is to fix prices. Such a consequence is not inconceivable. A standardized accounting system, programmed for a particular industry, might contain arbitrary expense allocation factors introducing such cost identity that uniform prices result from customary markups. There is authority validating industry product standardization to eliminate a glaring evil, if it does not create price uniformity. *Tag Mfrs. Inst. v. Fed. Trade Comm'n* 174 F2d 452, 462 (1st Cir. 1949). But the reasoning of such cases must be studied carefully for the limitations of the principle.

Similarly, the verbatim reproduction on tape or other media of copyrighted material (as distinguished from abstracting such material), the distribution of such reproductions, and the making of visual material from them probably violate the copyright laws.

Record Retention Policies

Computer use also may indicate the advisability of reviewing and revising record retention policies. Such policies should cover underlying original verbal records; punched cards, tapes, discs and other similar items; and verbal programs and machine program components. As computer record materials or printed translations of their contents are accepted as evidence, it may be appropriate to dispose of other types of original records, either immediately upon transcription onto punched cards or tape, or after a shorter period than presently observed. Such factors as statutes of limitations applicable to torts, contracts, taxes, antitrust, and other relevant fields of law will dictate the minimum periods for which essential records of any particular type must be retained. Business convenience may require longer retention. If any of the computer-type record materials will not endure for the requisite time, which is improbable, arrangements should be made for duplication before deterioration. If the record materials for such devices are more susceptible to damage by fire or other hazards, it may be necessary to adopt improved storage techniques or to preserve duplicate records.

Since machine records generally are substantially less bulky than conventional verbal counterparts, the businessman may be tempted to retain such records for longer periods than previously practiced. Any prospect of such a change should be scrutinized carefully, because there may be certain situations, such as in antitrust litigation, in which superannuated records prove to be more of a handicap than a boon.

Acquiring a Computer

The acquisition of a computer, either by purchase or lease, entails legal considerations related not only to the transaction by which it is secured, but also to the subsequent operations of the acquiring company.

The acquisition sales contract or lease must not require the purchase from the machinery seller or lessor of supplies, e.g., cards or tapes, repair parts, or maintenance service. Depending upon the facts,

such a restriction may violate Section 3 of the Clayton Act, 15 U.S.C. 14, *Int'l Salt Co. v. United States*, 332 U.S. 392 (1947), or Section 2 of the Sherman Act, 15 U.S.C. 2, *United States v. United Shoe Mach. Corp.*, 110 F. Supp. 295 (D. Mass 1953), *aff'd per curiam*, 347 U. S. 521 (1954).

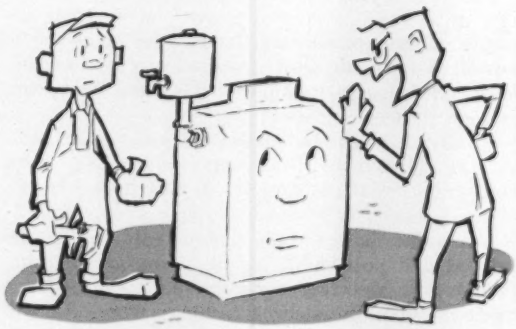
If the owner of the patents on a machine licenses its use only on condition that supplies be purchased from him, he will be disqualified to enforce the patents during the continuance of the practice. *Morton Salt Co. v. G. S. Suppiger Co.*, 314 U. S. 488 (1942). A lessor may, however, under the guise of protecting its good will, condition its leases on the use of repair parts conforming to reasonable specification. *Int'l Business Mach's. Corp. v. United States*, 298 U.S. 131, 139-40 (1936). Conversely, where the lessee intends to do maintenance and repair work with his own employees, he might provide specifically for the availability to him of replacement parts and components from the seller or lessor during the use of the machine.

If a company has patent rights on a process that entails the use of an unpatented computer or supplies, it may not license such process only indirectly through the sale or lease of such items. It must stand ready to grant direct licenses under the patent, leaving the source of the unpatented items entirely open. Otherwise, such a patent will be unenforceable on grounds of patent misuse. *B. B. Chem. Co. v. Ellis*, 314 U. S. 495 (1942).

Contracts for the purchase and lease of a computer and especially for the development or adaptation of a computer for a special purpose should specify the functions required by the purchaser in terms of objective standards by which compliance can be measured. An impartial, technically qualified third person as the judge of performance might be designated. Provision also should be made for the ownership and enjoyment of any patent rights that might result from a development contract. Any desire to bar the sale or lease of a specially built computer to others, if the device is not covered by patents owned by the company contracting for its manufacture, must be measured against the antitrust laws. Arguments that such a restraint is reasonable, being merely ancillary to a lawful transaction, like a restraint on engaging in an activity imposed in connection with a sale of a business or an employment situation involving the disclosure of trade secrets, probably would be persuasive. Especially would this be true where the customer made substantial contributions to the joint project, such as the payment of development costs outright, or the furnishing of technical ideas, secret data, or personnel with special qualifications.

In drafting machinery leases, provision might be made concerning the privilege of the lessee to make alterations in, or to use attachments or other devices with, the computer. In this regard, consideration should be given not only to the physical effect on the device of the action to be taken, but also to the disposition of any patent rights that might eventuate from such alterations. The validity of agreements providing for grant-back licenses or assignments of improvement patents that might be provided for in machinery leases or patent licenses, will depend in large measure on the facts of each case in the light of the patent and antitrust laws.

The acquisition of a computer may have other important ramifications of a legal nature in the company's operations that should be anticipated before the acquisition is concluded. In the area of employee relations, any collective labor agreement will have to be examined for provisions governing separations or job and salary reclassifications of personnel displaced by the new machine and the hiring of or the contracting for the services of persons required for its operation and maintenance. If it is planned to rent out time on the machine for its use by personnel of another company, will the labor contract of the possessor of the computer permit its machines to be operated by nonemployees?



. . . In drafting machinery leases, provision might be made concerning the privilege of the lessee to make alterations in, or to use attachments or other devices with, the computer . . .

Where business documents, such as order confirmations, invoices, and checks will be created by the new device, contemplated forms should be examined in advance to insure that they will satisfy all legal requirements for contracts or negotiable instruments and, particularly, of the rules of evidence. This is essential if printing and punching will be performed simultaneously and the location of the printing on the form is strictly limited.

Buying Machine Time

It may be more economical to buy computer services from someone else than to acquire a computer, especially one of the more expensive, sophisticated machines. The legal facets of arrangements for outside processing relate to a wide variety of matters

such as methods of payment for service, use of programs, ownership of tapes, scheduling and hence availability of service, personal injury liability to outsiders on the premises, security of the data being handled, and liability for errors. These points, which are of interest equally to the customer and the service unit will be considered in detail. Where the term "service bureau" or its equivalent is used, the comments also are applicable to persons using a machine primarily for themselves but selling computer service.

Payment Terms. Methods of payment for service have no legal significance, apart from the importance of covering them clearly in the service agreement. Charges might be by the month or other period, by hourly machine time used, or for the value of the variety of services actually rendered, based on a schedule of rates. Computers can calculate charges for their use as they perform service. Charges also might take into account consultation on programming or the use of a special program designed by the service unit.

Program Ownership. Where the program owned by the customer will be used by the service bureau, legal problems should be anticipated and minimized. Provision should be made for the physical security of the program component. If the program is unique and has competitive advantages, it might be advisable to forbid its use for processing the data of others and the disclosure of its contents.

Service Availability. A customer should anticipate his processing requirements and provide specifically for the availability of the necessary machine time during the contract term. Provision might be made for allowable delays both in furnishing data and in processing them; for liquidated damages for excessive delays; for guaranteed maximum machine time or volume of data to be processed, taking into account any anticipated expansion of the customer's needs; and for the obligation of the service company to provide continuous service regardless of machine breakdown or more major catastrophes, including labor disputes. Most of these factors are important to the customer to the extent he is dependent upon uninterrupted computer service.

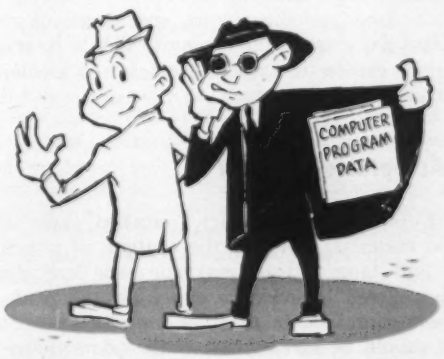
It might be advisable for a company that has its own computer, and finds that substantially continuous functioning is essential to its operations, to contract with a service bureau or other user of the same type of machine for the constant availability of a specific quantity of machine time as an insurance device in the event of an emergency. The payment of a nominal fee to the bureau would be appropriate to induce it to keep the standby obligation in mind and to make arrangements to be able to fulfill it on short notice. Reciprocal emergency assistance arrangements with other machine users are becoming increasingly common.

Business Visitors. Where customer personnel come on the premises of the machine user to process data, greater precautions may have to be taken to avoid personal injury, especially if the visits occur during off hours.

Security Problems. Service companies must assume responsibility for guarding not only the physical condition of their customers' tapes and punched cards, but also the security of the information contained on them. The maintenance by the customer of a duplicate tape or set of cards will provide protection against destruction and will serve as a check on tampering. Nevertheless, the service company must establish controls that will prevent meddling with the data submitted to it, such as the alteration of the business records to benefit persons dealing with the customer or the unauthorized disclosure of confidential information. Similarly, the outside processing of data might impose on the customer a greater duty to check on the accuracy of its records than is necessary where records are kept internally.

Mistakes. To minimize its potential liability for errors in processing its customer's data, a service bureau might insist that all cards and tapes be created by the customer and that all machine work be done under the personal supervision of the customer's employees. Service contracts always should provide for the nature and extent of liability. The general legal situation probably is analogous to that involving the transmission of telegrams and similar messages. However, before obligating itself to permit the operation of its machines by outsiders, the company renting out machine time should verify that its labor contract permits it.

Refusals to Deal. As the processing activities of service bureaus grow, they must be alert to legal liability stemming from a refusal to serve an applicant. The creation of any public utility status, which might arise as specialized processing operations are offered to particular industries, will depend on the practicality of there being alternative sources of an indispensable service. Such a development appears to be quite remote at the present time, but it cannot be ruled out entirely. Any agreement restricting the availability from a service bureau of a type of machine service or program should be evaluated carefully under the antitrust laws and, where a patented machine or process is involved, under the patent laws as well. This consideration probably



. . . the service company must establish controls that will prevent meddling with the data . . . or the unauthorized disclosure of confidential information . . .

would not be applicable to a commitment protecting the secrecy of a program designed by or for a particular customer.

Providing for Maintenance

Computer maintenance has legal ramifications relating both to the freedom of the machine user to select the source of service, and to precautions to insure fairly continuous machine functioning.

A computer user may provide for maintenance and repair services through his own personnel, the machine lessor, or an independent serviceman. Any standard established by the lessor with respect to repair parts specifications or quality of maintenance service must be designed reasonably to protect its good will and not to dictate the source of the parts or of the service function.

Where sustained computer operation is critical, any contracts for outside repair service should insure, at the very least, that the manpower and the parts will be available when required. Permissible delays should be provided for specifically, as should penalties or the means for measuring damages in event of breach of the duty to respond promptly. A performance bond might be required from the maintenance company to cover the cost of losses for which it is responsible and which could be substantial.

In order to minimize losses from interruptions in computer operation due to parts failures, as well as to reduce errors caused by transitory malfunctioning, there is merit in providing for continuous maintenance supervision. This could provide for regular testing to determine the remaining life of components susceptible to such treatment and for replacement of components in advance of failure on a schedule reflecting their average life expectancies. Again, the establishment of penalties for breach of such a duty by an outsider might be essential to compel its scrupulous observance.

If maintenance and repair service is contracted for at a fixed periodic charge, the extent of contemplated daily use of the computer should be specified, since greater use would increase the incidence of parts wear.

Acceptable Evidence

With increasing frequency, punched cards and printed material, reflecting the contents of punched cards and tape and of magnetic tape and discs, will be offered in evidence either for the truth of the facts contained in them or for other purposes. There should be no question of the admissibility of such evidence, where otherwise appropriate, merely because of the form in which it exists. For example, it should come within the various "business records" statutes or the equivalent common law exception to the hearsay rule. The conversion of original written records, such as salesmen's delivery tickets, into input or storage means not readable visually should not diminish the evidentiary usefulness of the latter. As long as the cards, tape, or discs are used in the regular course of business, the same assurance of trustworthiness is present as if the underlying records themselves were relied upon. Hence, the nature of the data, rather than the form in which they are recorded, is the significant factor from an evidentiary point of view.

Where nonverbal data, such as punched cards that record symbols, are to be offered, it will be necessary to produce either written decoding instructions or a witness to translate the symbols into meaningful words.

In relying upon data processed by a machine, there should be no more necessity for oral testimony concerning the reliability of the machine operations than that of the manual procedure supplanted, whether it be bookkeeping, order preparation, or mathematical computation. Again, the reliance upon the processed information in the regular course of business should guarantee trustworthiness. However, if a court is unsatisfied, the machine program can be described to support the validity of the end product, and a computer consultant or qualified machine operator could furnish evidence to allay fears of any errors introduced by the internal processing.

Best Evidence Rule

Ordinarily, the original of a document must be offered in evidence, unless its absence is accounted for satisfactorily, that is, its destruction has not been intentional. This rule is not a fundamental one, and may be waived. Furthermore, its application varies widely. In some jurisdictions, books of account are not regarded as original documents, and the underlying papers are preferred. In others, the reverse is true. However, some of the former are content to admit the secondary evidence readily, if the initial records have been destroyed routinely. If such records are retained, the party obligated to produce the evidence must decide whether use of the punched card or tape is so much less burdensome than ferreting out the basic paper that an effort should be made to rely upon secondary evidence. Documents created by computers, such as customers' accounts, computations, and decisions, should be the "best evidence."

A similar "original document" question relates to the punched cards or magnetic tapes vis-a-vis the data printed from them. Are the cards and tapes the original documents, especially where they are not readable visually, or are they merely the means for printing documents, like printing type or plates? Probably, the latter is the more correct characterization, in which case all documents printed from them are duplicate originals on a complete parity.

Apart from punched cards that contain microfilms

as integral parts, any analogy to the rules relating to the treatment of microfilm records as evidence is probably apt only to computer records that are either a direct machine recordation of a document or the source from which the document was created automatically.

Determinations by Computers

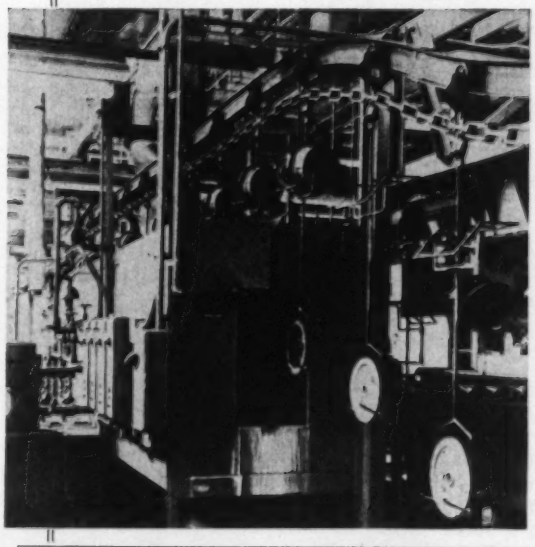
Interesting evidentiary situations might arise involving the use of computer determinations. Examples might be a medical diagnosis in a malpractice suit and a corporate decision in an antitrust action. In the former, such machine determination might be urged as evidence of reasonable care to negate the charge of negligence. If all of the available symptoms were furnished the computer correctly, and if the completeness of the symptomatology committed to it were established, would the diagnosis by the machine be an expert opinion relating to negligence, such as is required in malpractice suits? Currently, computers probably are intended only as memory reinforcing devices rather than as sources of conclusive diagnoses. In the antitrust example, efforts might be made to avoid the treatment of the machine decision as an official corporate act. Apart from the underlying merits, it would seem that writings, manifesting such business decisions and created directly from the magnetic tape or other storage means, should be admissible in evidence. Those writings probably would require supporting explanations, either oral or written, directed to the weight to be given them. Depending upon the specific facts that may be involved, it is entirely possible that the "business records" rule would authorize admission of such evidence.

Where a machine translation of a document in a foreign language is offered, it probably will be necessary to establish the qualifications of the machine program in much the same fashion as those of a human translator. Of course, the opposing party always could offer in evidence any contrary interpretation of the document. In many cases where analyses and tabulations of great quantities of data will be offered in evidence, resort to a computer can be extremely helpful. Such underlying data might constitute either accumulated business information or the results of surveys or polls conducted specifically for use in litigation. Prior to the availability of computers, those analyses were made by persons with statistical and other appropriate analytical skills, and they were considered for admissibility on the basis of the reliability of the supporting data and of the process of their manipulation. The use of a computer to facilitate the preparation of the evidentiary end product should detract in no way from its admissibility.

Contact Your Lawyer

As you can see, the legal implications of computer use stem more from the uniqueness of the technology than from the need for new rules. Because the fact situations in which legal questions will arise will be foreign to many lawyers, it will be wise to educate your legal counsellor by exposing him to the ways you are using the new electronic technology. Having been educated, your lawyer should be put on your computer planning team as early as possible to insure that no legal niceties or special precautions will be overlooked at the risk of substantial future expense.

single conveyor does double duty

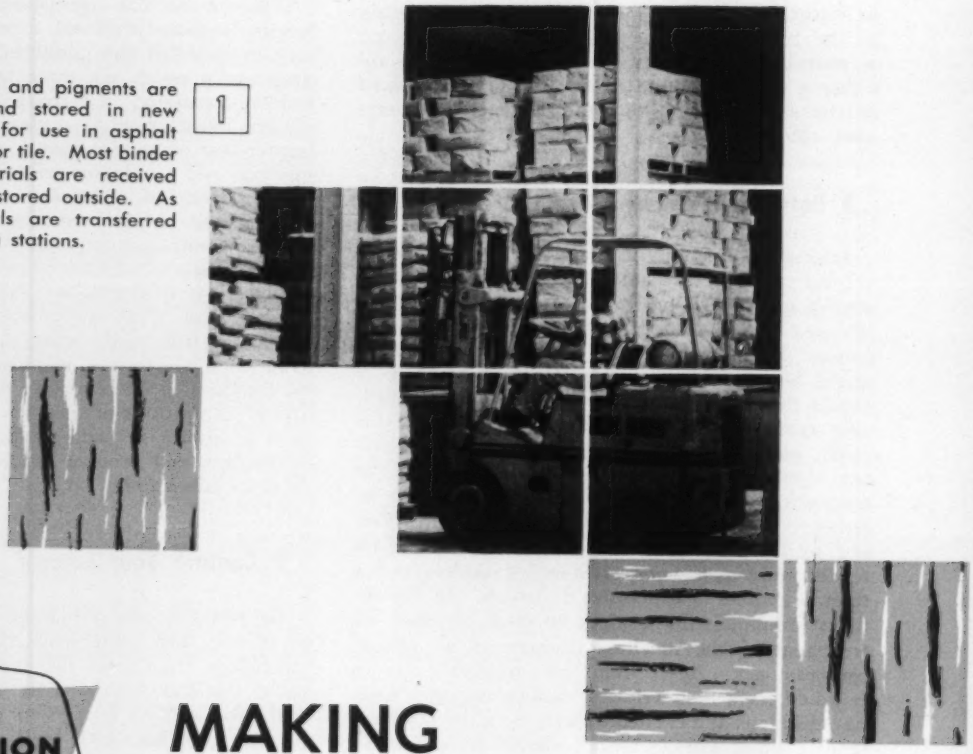


TWO-STAGE washer is served by monorail conveyor that is external to a washing machine at Hotpoint Div., General Electric Co. A slot in the top of washer, provided with neoprene seals to minimize loss of steam, permits work holders to extend down into the washing chambers. As one advantage, this design protects the conveyor from corrosive wash solutions (solution tanks are heated by steam coils to 190 F, and liquid is sprayed through 105 nozzles at 15 psi pressure).

Another interesting advantage to the hanging work holders is that they can be used to convey parts that need not, or should not, pass through the washer. In use, matching parts essential to the assembly of the part being washed are placed on the upper tier of racks on each carrier. This arrangement permits parts upon which machining operations are to be performed, to be conveyed on a single conveyor without requiring them to pass through a hot solution. Two savings result: Time is not wasted in waiting for parts to cool prior to machining, and washing effort is not wasted on parts still requiring a machining operation. The two-stage washer was built by the DeVilbiss Co.

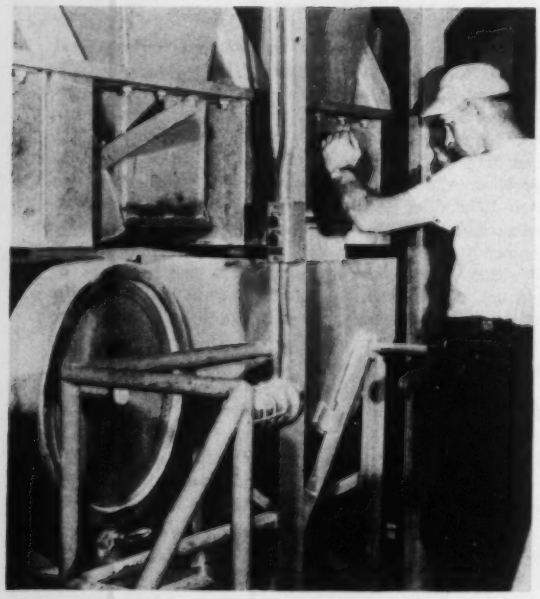
Asbestos fiber, fillers, and pigments are received in bags and stored in new Johns-Manville plant for use in asphalt and vinyl asbestos floor tile. Most binder and plasticizer materials are received in metal drums and stored outside. As required the materials are transferred to bins and weighing stations.

1



AUTOMATION TODAY

MAKING FLOOR TILES



MANUFACTURE of resilient floor tiles is high level activity even though most people simply step on these products. The industry produces asphalt asbestos floor tile at a rate of about one billion square feet per year. It also produces vinyl asbestos floor tile at a rate of about one-half billion square feet per year.

A large share of this floor tile output is produced by Johns-Manville Corp. which recently added to its capacity by building a new multimillion dollar plant at Chillicothe, Ohio. Automatic controls are used in a semiautomatic manufacturing setup that increases the company's total floor tile productive capacity by almost 50 per cent.

2

Operator is weighing out material from a bin into a dumpable hopper. When weight specified by formula is attained, the hopper can be tilted to dump contents into a bucket positioned on an overhead monorail system. Pigments are weighed to one-hundredth of a pound on sensitive scales to meet formula requirements.

The plant provides more than 100,000 square feet of manufacturing and warehousing floor space and will serve an 11-state midwestern market. The plant buildings include a one-story manufacturing area with a 3-story materials section at one end. Equipment layout was designed by the Johns-Manville General Engineering Department to performance specifications of the Building Products Division, which operates the plant.

Basic materials used in making asphalt and vinyl asbestos floor tile include binders, plasticizers, asbestos, fillers, and pigments. Asbestos fiber, fillers, and pigments arrive in bags and are stored in the plant for use in the production cycle. Most binder and plasticizer materials are received in metal drums and stored outside the plant.

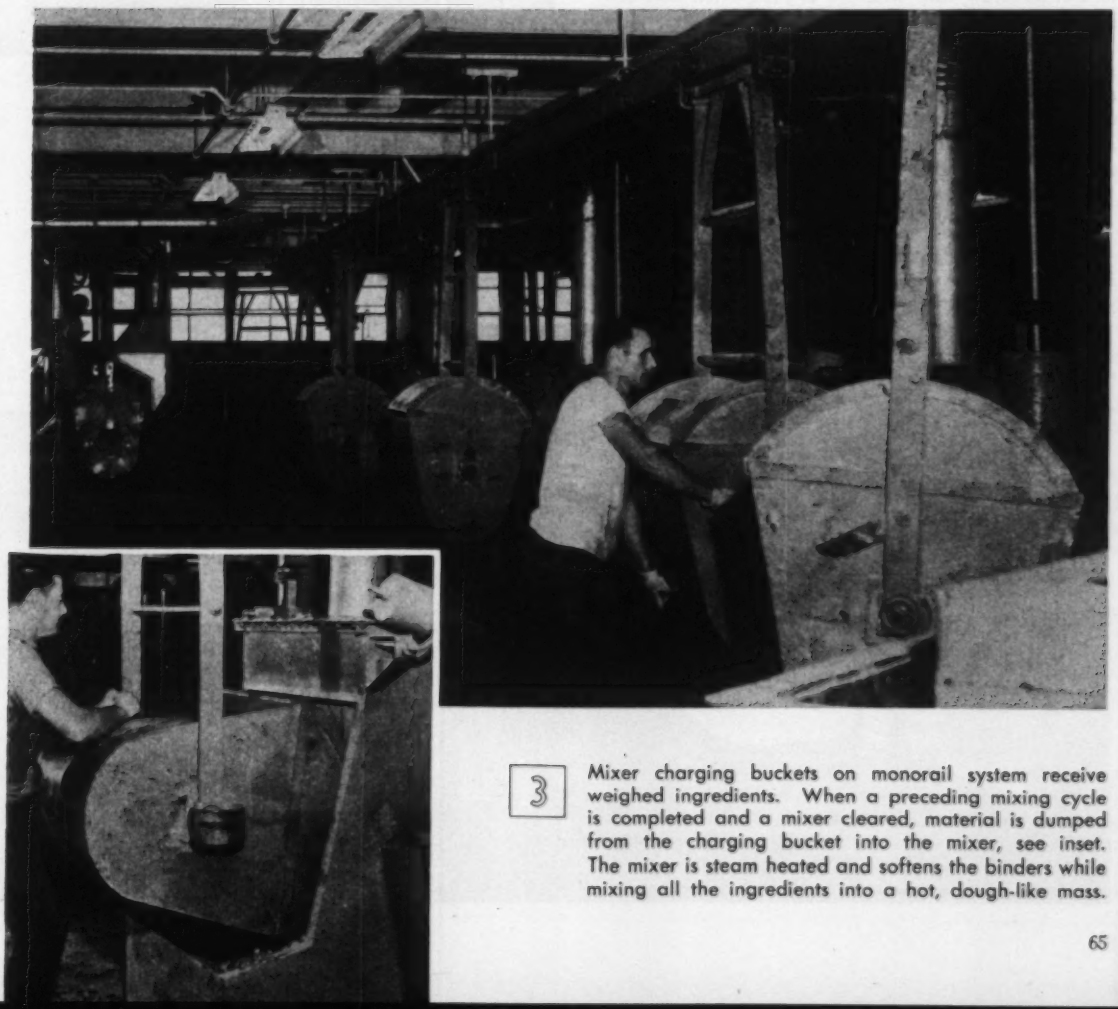
Thermoplastic binders, short fiber asbestos, mineral fillers, and inert pigments are mixed with pitch to produce asphalt tile. The thermoplastic binders consist of hydrocarbon resins compounded into binders by admixture with toughenners, softeners, and other additives. Short fiber asbestos is added to the asphalt tile mix to restrict plastic flow and give the product added mechanical strength.

Surface appearance of the tile is designed by adding mineral fillers of limestone, dolomite, or marble dust. Marbleization or other pattern effects are created during the milling operations. Preformed chips of contrasting colored tile are blended with the mix and produce marbleizing or veining. Coloring is controlled by adding titanium, iron oxides, and other inorganic pigments.

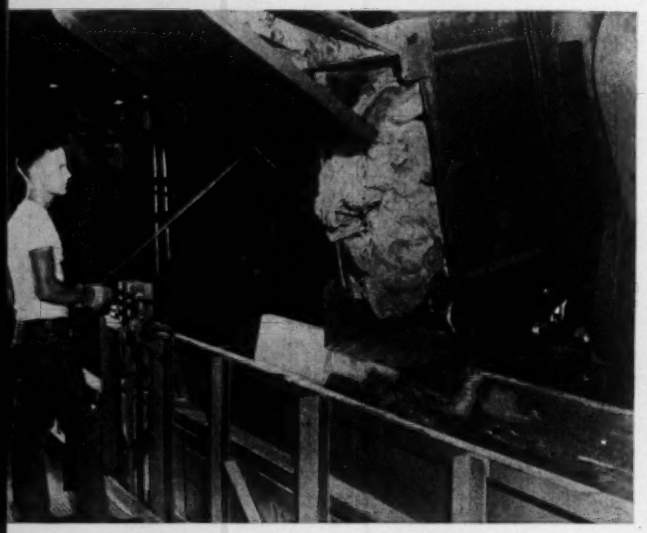
Production of vinyl floor tile is similar to that of asphalt tile but some ingredients are different. Also, the processing temperatures and handling procedures must be adapted to the requirements of vinyl polymers. Binders for vinyl floor tile consist principally of copolymer vinyl chloride-acetate resins compounded with plasticizers, stabilizers, and other additives. Asbestos fiber is again added to impart mechanical strength and dimensional stability.

In the floor tile manufacturing process, the resinous binders and fillers are transferred from storage to an operating area on the third floor where they go into bins. They are weighed out of the bins and dropped into hoppers on the second floor. Plasticizers, asbestos fiber, and pigments are moved from storage to the second floor. These ingredients are also weighed out, and all these materials are dumped into mixer charging buckets carried by a monorail system.

The properly proportioned mixes are dumped into



3 Mixer charging buckets on monorail system receive weighed ingredients. When a preceding mixing cycle is completed and a mixer cleared, material is dumped from the charging bucket into the mixer, see inset. The mixer is steam heated and softens the binders while mixing all the ingredients into a hot, dough-like mass.



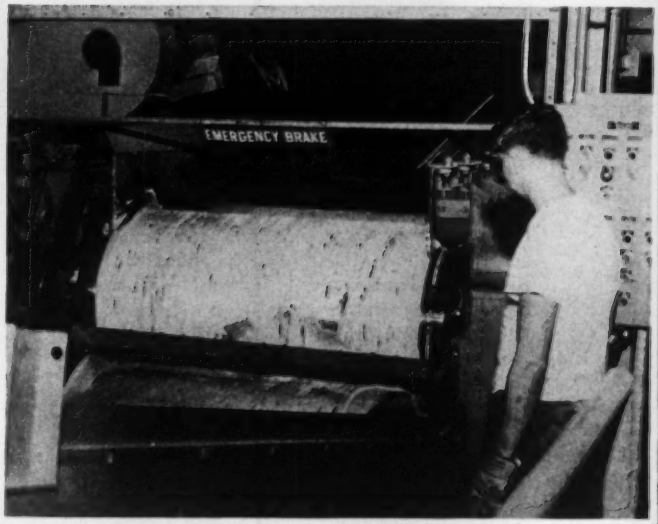
4

After mixing for a controlled time at a controlled temperature, the tile dough is discharged from the mixer. Here an operator is supervising the dumping of the mix onto a conveyor which will take it to the continuous roll milling machine.

large steam-heated batch mixers. The binders are melted to a soft consistency and the ingredients are mixed to produce a hot, dough-like mass. This dough is discharged onto a conveyor and transferred to a fractioning mill where it is compacted and consolidated.

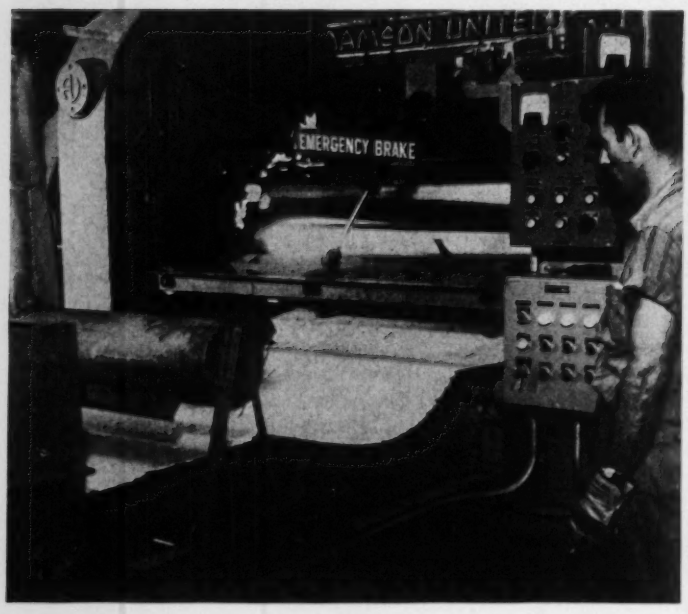
Enough dough goes to the mill to cover the front roll and form a small backlog at the bite, thus ensuring a constant, even supply. During milling, chips are added for marbleization or pattern effects. After all necessary chips are added, the dough is remilled and then automatically transferred in slab form to the first calender.

Three successive calenders are used to roll the



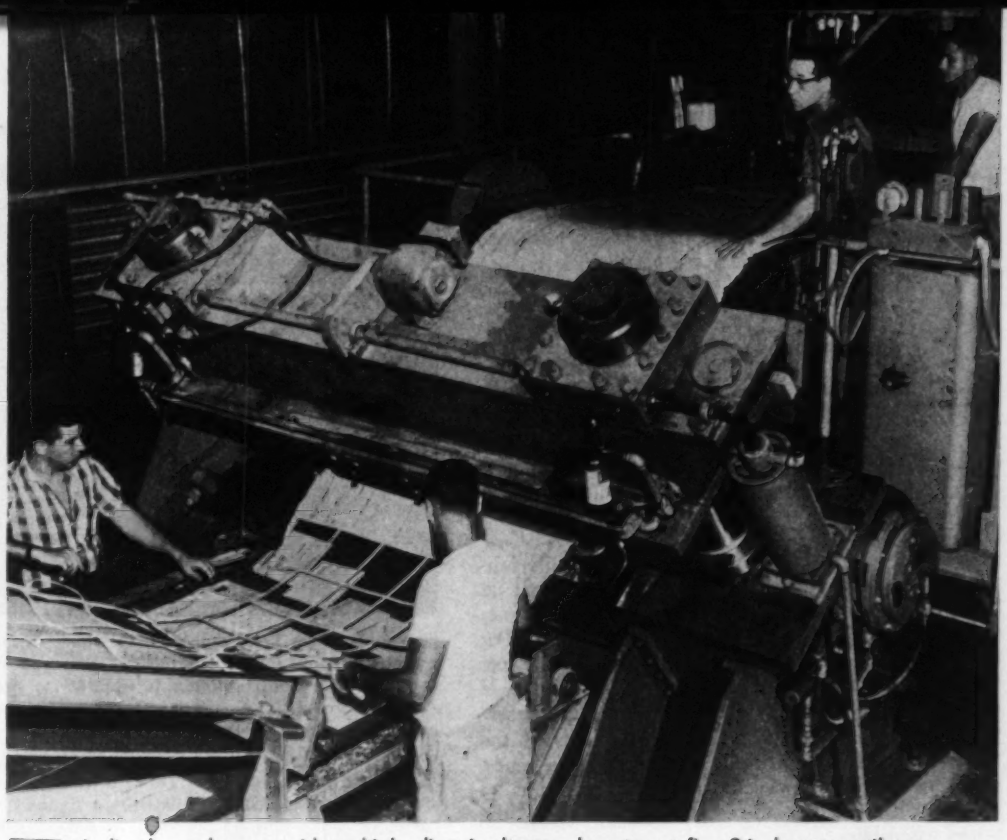
5

Rolls in the milling machine continuously knead and compact the dough-like mix into a slab of floor tile material. To obtain marbleized or veined effects, chips of contrasting colored tile can be added during the milling operation and worked into the slab. This slab is automatically conveyed to the succeeding operations.



6

This is one of the three calendering machines which further work the tile material and reduce the thickness of the strip to desired dimensions, usually 1/16 or ⅛ inch. After the hot strip leaves the third calender, it is partially cooled by a water spray. Wax is then applied to it and it is cooled further by an air system. A wire mesh conveyor carries the sheet through these operations and to a punch press.

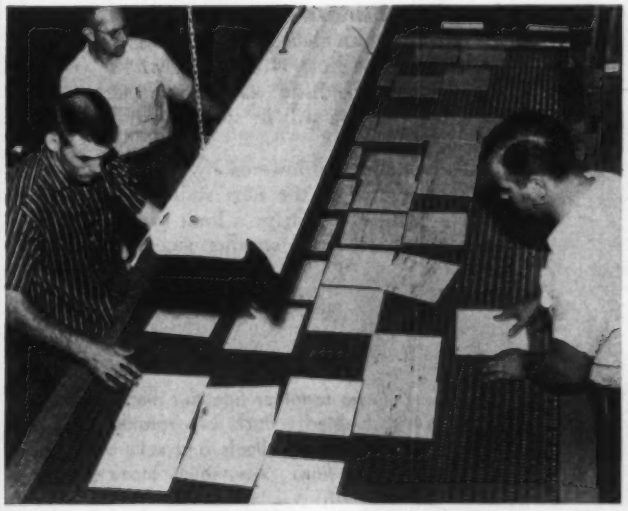


7 Inclined punch press with multiple dies simultaneously cuts out five 9-inch square tiles across the sheet of tile material. The tiles are carried to a refrigerated air cooling operation by the bottom conveyor at left. The inclined conveyor above it carries the remaining skeleton frame of the strip to a cutting device. The cut pieces of frames are later crushed and weighed into succeeding mixer charges.

hot dough into a tile sheet of desired thickness, usually 1/16 or ⅛ inch. The sheet travels from the third calender on a wire mesh conveyor, through a cooling water spray, a wax applying operation, and an air cooling system, to a punch press.

Tiles 9 inches square are stamped from the sheet and separated from the frame of material which is left. As the tiles advance on another conveyor they are cooled further, inspected, and then packaged. The packaged floor tiles are loaded on pallets and transferred by fork trucks to storage areas to await shipment. Control loops in the process regulate operation times and temperatures in mixing and milling. Other loops control temperatures, speed, and strip thickness at the three calenders. Temperatures are also regulated in the cooling operations.

The accompanying illustrations show some of these operations in the production of floor tile at this plant. Johns-Manville engineers describe it as the most up-to-date manufacturing facility in the floor covering industry.



8 After the final cooling, finished tiles are inspected as they advance to the packing operation. When the tiles have been packed in cartons they are moved to the warehouse for shipment. Reject tiles culled out by inspectors are crushed with the frame pieces and returned to the mixers.

WHEEL ASSEMBLY LINE

SUPPLYING main production lines with sub-assemblies—in the quantities needed and at the proper times—is a problem that assumes major proportions in the automotive industry. For example, at Pontiac Motor Div., General Motors Corp., wheel assemblies are prepared and fed to a chassis assembly line by a separate line that incorporates many automatic features. Functions of the wheel assembly line include soaping of tire beads, applying valves to wheels, mounting the tires to the wheels, inflating the tires, and balancing the wheel assemblies.

Tires reach the wheel assembly line on hooks of an overhead chain conveyor. At Station 1, *Fig.* 1, driven rolls are elevated to lift each tire from its conveyor hook and rotate the tire against a roll that applies soap solution to the tire beads. The soap solution is fed automatically by air pressure. After the tire has rotated a few revolutions, the driven rolls are lowered and the tire is returned to its conveyor hook.

Wheels roll in a channel to Station 2 of the wheel assembly line. At this station, each wheel is oriented to receive an air valve. The valves are fed from a hopper via a magazine and are seated in grooves in the wheels by an air plunger. Where wheels are to receive standard hub caps, fastening clips are applied manually to the wheels.

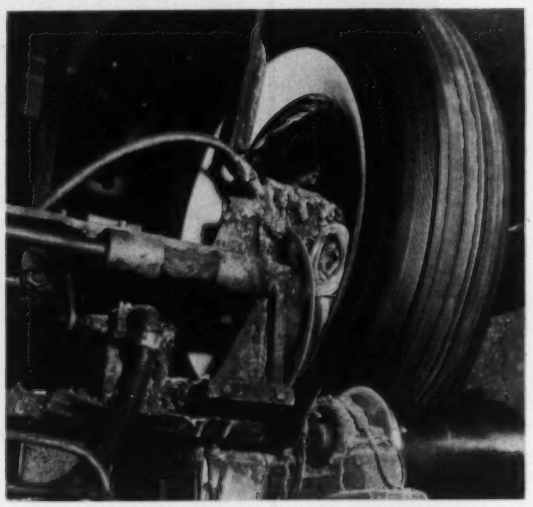


Fig. 1—Tubeless tires, delivered to wheel assembly line by chain conveyor, are lifted by powered rolls and rotated while soap solution is applied to tire beads. After several revolutions, tires are lowered and redeposited on conveyor hooks.

At Station 3, an air operated slide pushes each tire off its conveyor hook onto an inclined plate. The leading tire on the plate is then fed over, and nearly concentric with, a wheel moved horizontally on a conveyor. Wheels and tires next move to a mechanism, *Fig.* 2, where the tires are assembled to the wheels. In operation, shoes press each tire against a wheel rim. The assembly is then rotated slowly as rollers on arms force the tire beads over the rim.

Wheels with valves and tires are next conveyed to an inflation machine at Station 4, *Fig.* 3. Here, each assembly moves against a stop and is lifted by a ram to an inflation head. With the head seated against the wheel rim, air at 100 psi enters the head and flows between the rim and the tire bead to inflate the tire. When pressure in the tire reaches 30 psi, air flow is shut off and the air between the head and wheel is exhausted through a muffler. A safety feature of the inflation machine is that if a wheel rim fails to seat against the head, as might occur with a cocked wheel, the ram will be stopped automatically.

Inflated wheel assemblies are lowered by the ram and proceed on a conveyor to the next station. As an assembly leaves Station 4, it trips a limit switch that starts a feed cycle to move another assembly into inflation position.

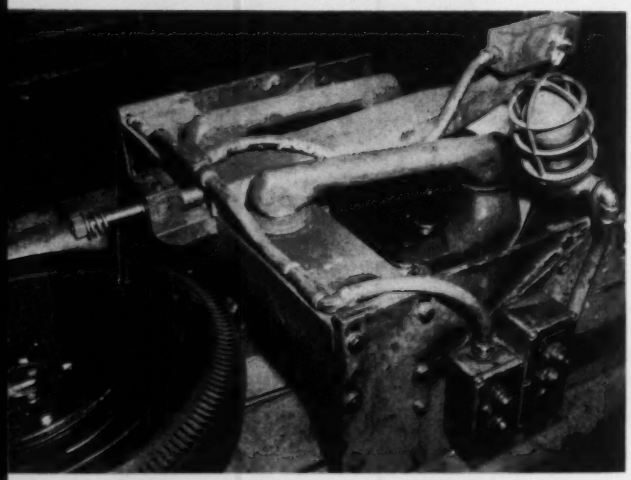


Fig. 2—Tires and wheels move together into this mechanism where they are assembled. Parts are rotated slowly as tires are pressed against wheels and rollers force tire beads over wheel rims. Assemblies move toward next workstation at left.

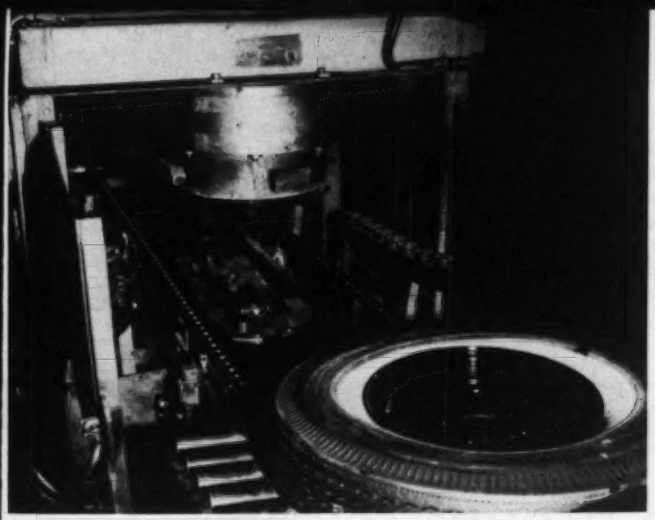


Fig. 3—Wheel assembly, foreground, is shown entering inflation machine. Assembly is stopped above ram, center, and lifted by ram until wheel rim seats against inflation head. Compressed air entering the head then inflates the tire. When head pressure is released, inflated assembly is lowered and discharged from machine.

On the way to Station 5, each wheel assembly is passed through a turnover device so that its valve projects downward. Assemblies in this condition are then moved to an electronic static balancing machine, *Fig.* 4, at the station.

Wheel assemblies to be balanced are centered automatically on a rocking pilot, and an automatic printing head is lowered over the wheel. An assembly that is unbalanced statically will tilt on the pilot such that the heavy side of the assembly will lower in proportion to the amount of unbalance. During this process, a print wheel on the printing head moves automatically to an angular position opposite the heavy point of the assembly. The print wheel then rotates until its outermost numeral corresponds to the amount of unbalance. This numeral is stamped on the wheel rim near the high, or light, point of the rim when a solenoid is actuated to swing the print wheel outward. Thus, the wheel prints a number on the rim that indicates where a balancing weight is needed and how heavy it should be to balance the wheel assembly statically.

When a wheel assembly has been marked, the printing head is raised and the assembly is discharged onto a conveyor. At Station 6, an operator manually assembles a lead balancing weight to the wheel rim. The weight is of the size indicated and is placed next to the marking.

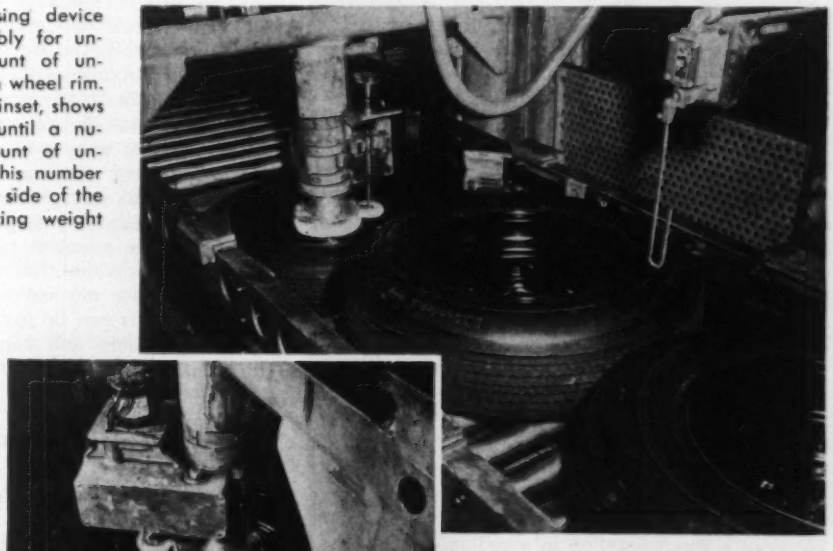
The operator at Station 6 segregates the balanced wheel assemblies into groups of five for each automobile by shunting them to each of three sloping conveyors. Two wheels of a group are pushed onto a left conveyor, two onto a right conveyor, and a fifth wheel (the spare) is pushed onto a central conveyor.

At the bottom of each conveyor there is a mechanism that shifts the wheel assemblies from a horizontal to a vertical position and transfers them to carriers of an inclined conveyor. Automatic gates separate the assemblies for one chassis.

The inclined conveyors elevate the wheel assemblies from the basement to a main floor area where the chassis assembly line is set up. There, hooks on overhead chain conveyors pick up the assemblies and deliver two to each side of the chassis line where they can be removed as required by assemblers. The spare is also delivered to this point.

Production rate of the wheel assembly line is 225 assemblies per hour with five operators. Since a shutdown of this line could affect operations on the main chassis line, and perhaps in other areas, an older manual wheel assembly line has been retained. This line is used on a standby basis when the automated line is being repaired.

Fig. 4 — Automatic sensing device checks each wheel assembly for unbalance and marks amount of unbalance at proper point on wheel rim. Close-up of printing head, inset, shows print wheel that rotates until a numeral indicating the amount of unbalance faces the rim. This number is then printed on the light side of the assembly where a balancing weight is required.



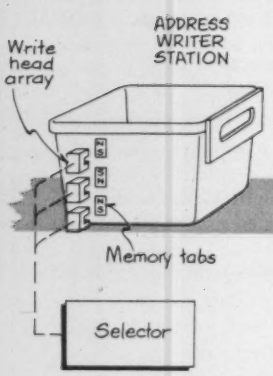


Fig. 1—Typical magnetic address system for a conveyor is shown. In this case the memory tabs are metal plates on the side of a tote box carrier. Each carrier is coded magnetically with identification intelligence at the address writer station. At Reader Station 1 the magnetic intelligence on the memory tabs causes an item to be released into the carrier. At Reader Station 2 the intelligence is not correct to cause the diverter to operate and shift the carrier to a spur conveyor. At Reader Station 3 the coded intelligence matches the signals of the read head array and causes the carrier to be diverted. On each read head a notch indicates the north pole of the head.

MAGNETIZED ELEMENTS CONTROL

CONVEYOR DISPATCHING SYSTEM

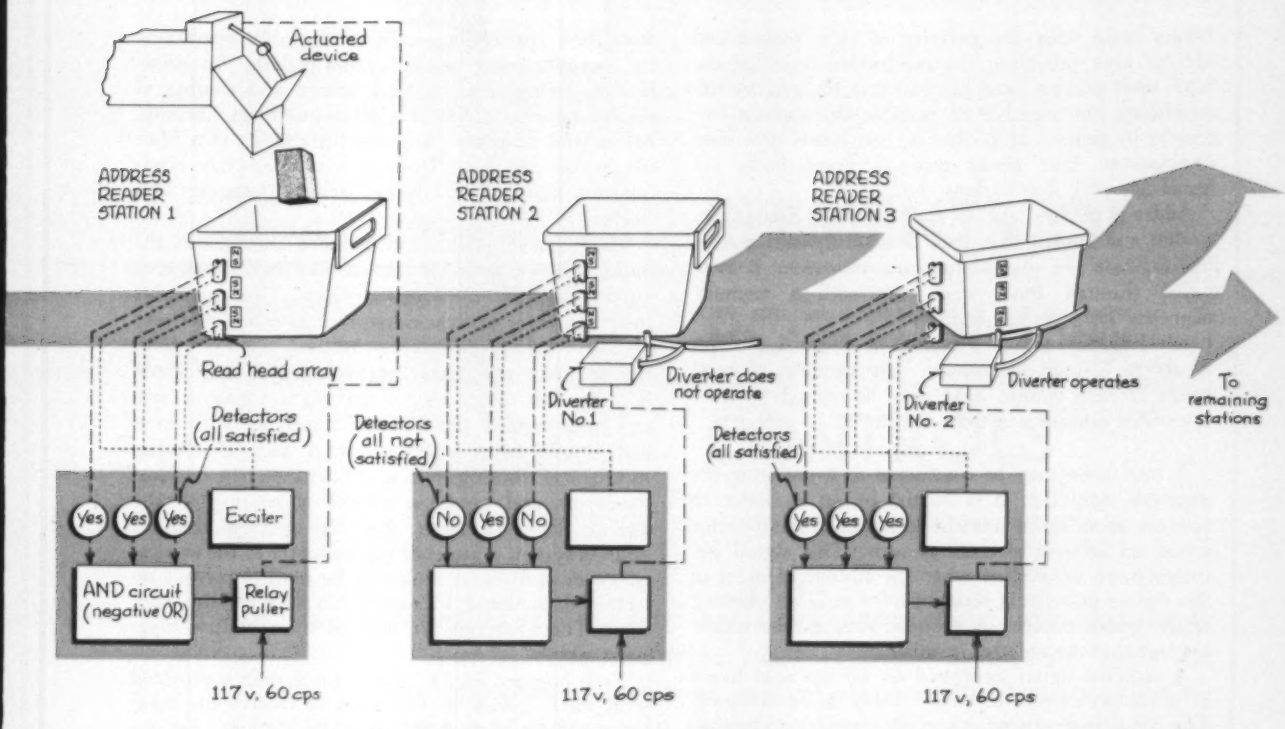
Using the principles of magnetism, a dispatching system for use with vertical and horizontal conveyors provides a unique method for routing carriers and/or products to selected stations. Unusual system flexibility is provided since address writing and address reading stations are not physically connected with each other.

INTEGRATING link in many automated systems is usually some form of conveying means by which parts, assemblies, or finished products are transported from one point to another. The types of conveyors available for this purpose are numerous—gravity roller, live roller, belt, chain, cable, elevating, etc.—and control of unit movement is of minor importance as long as the items are being moved sequentially from station to station, machine to machine, or area to area. However, many production operations require a capability of dispatching units from one or more stations in a system, moving them through the system, and identifying a particular unit at a specific point for removal from the system or for the addition of other items to the unit. Operations of this type require a control system to receive the instruction intelligence at the dispatch stations, transmit the intelligence to the removal or addition station, and to identify the unit and actuate proper work performing devices at the selected station.

Two distinct methods are presently being used to transmit the intelligence necessary to initiate action at a specific station in a system. One method involves entering the intelligence into a separate transmitting means such as a magnetic tape belt or an electronic shift register which is synchronized to move or shift the intelligence at a proportionate speed and distance as the conveyor moves the unit. When the unit on the conveyor reaches the specified station, the intelligence energizes actuating devices to remove the unit or to add additional items. The second method involves applying the intelligence directly to the item or its carrier in the form of a mechanical tab or pin, printed code on a box, or strips of tape attached to the item. This method permits considerable flexibility in system design and operation since mechanical, electrical, or electronic sensing means can be installed at any point in the handling system and can be readily moved to a different point when production conditions change.

▶ Magnetic Intelligence

A recent development has been the use of magnetic principles to apply, hold, and sense routing intelligence on a conveyed unit or its carrier. Such



a system has been developed by Maico Electronics Inc. and can be applied to control product routing on vertical and horizontal conveying systems of all types. The magnetic address system is designated as Maitrol and is composed of modular components which can be combined in various ways to make up a functional system. These components consist of three basic elements which are address writers, magnetic memory elements, and address readers.

A basic magnetic address system is shown in *Fig.* 1. The address writer station consists of a selector—a dial, pushbuttons, or other selective electrical switching devices—and a write head array. The setting of the selector for a particular removal station automatically switches direct current to either of two windings on a series of C-shaped cores in the write head array. Depending upon which pole of a core is energized, either a North-South or a South-North magnetic field is established. By various combinations of core magnetic fields, a code can be established such as *N-S, S-N, S-N* for Station 1; *S N, S-N, S-N* for Station 2; *N-S, S-N, N S* for Station 3 and so on for all possible combinations.

As the product or its carrier passes the write head array, the coded magnetic intelligence, which indicates destination, process, or part number, causes the memory elements on the product to be magnetized in a definite polarity pattern. The memory elements can be a series of metallic tabs on a nonmetallic carrier, a metal carrier itself, or the product itself such as metal food cans in a cardboard carton, *Fig.* 2. Depending upon the number of stations in the system, the memory elements can be stacked into a single vertical or horizontal array or may be two or more stacks to accommodate a larger number of tabs.

The basic code used with the system is a simple

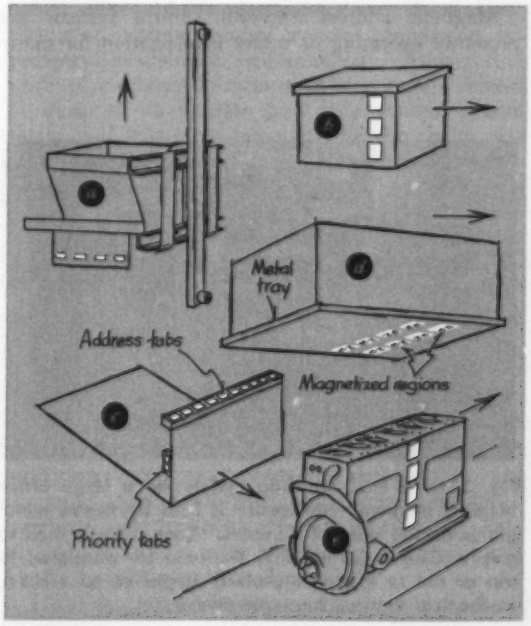


Fig. 2—Various techniques can be used to hold the magnetic intelligence impressed by an address writer. For vertical conveyors *(a)* the memory element can be a plate attached to the carrier. Metal plates on the side of a tote box *(b)* or across the top of a skid *(c)* can be used for horizontal conveyors. In some cases the bottom of a metal tray *(d)* or the product itself *(e)* are sufficient to hold the intelligence. Main consideration in selecting a technique is that magnetized area should pass within ⅜ inch of the address reading heads.

binary code with the polarity of each magnetized address area providing the destination intelligence. Since each address head has two possible magnetized conditions, the number of possible destinations increases by powers of 2, that is, two heads give four destinations, four heads give 16 destinations, six heads give 64 destinations, etc.

Address readers are located at each destination station and consist of a read head array and a control cabinet. As the product and/or carrier is conveyed through the system, the address memory elements are brought in proximity with the read heads located at each destination. Normal spacing is about $\frac{3}{8}$-inch clearance. The number of read heads at each station need only be enough to read the coded address for that station.

A read head may be considered as a nonsaturable magnetic amplifier. It is excited by an oscillator to produce an offset or unsatisfied signal to the detector when no address element is near. This signal becomes more unsatisfied when an address element of the wrong polarity is brought near it. If an element of the coded polarity is brought near it, the resulting signal to the detector is satisfied.

A satisfied signal impressed on all the read heads at a station causes an output relay to be actuated. The contacts of this relay can be connected to mechanisms for removing the product and/or container from the conveyor or for adding additional items to the product and/or carrier. Since the read head array is concerned only with polarity and is not rate sensitive, any ordinary conveyor speed is well within its operational limits. In most cases speeds of about 300 feet per minute can be used. The real limiting factor on conveyor speed is mechanical. Time must be allowed for relay actuation and for mechanical operation of diversion or additive devices.

▶ Operating Installation

Magnetic address conveyor control systems are presently operating or under investigation for many diversified applications such as assembly operations in manufacturing plants, order-picking in warehouses, sorting mail in post offices, and routing of papers, records, and mail in office buildings, libraries, banks, and hospitals. A recent installation of a Maitrol system has been made in a new 52-story headquarters building of Union Carbide Corp. in New York.

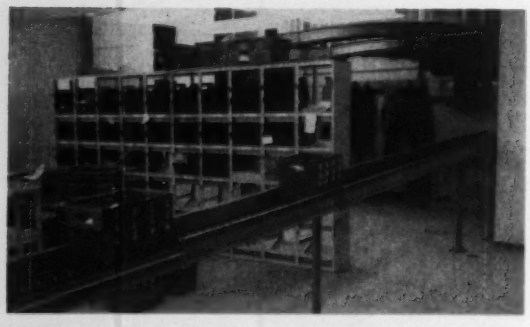


Fig. 3—In a mail handling system for a large office building magnetic intelligence is held by twelve metal plates on the sides of hampers. Each plate is used to give a Go-No Go reading that can be translated to trip or not to trip a mechanical finger on an electromechanical vertical conveyor control.

Mail and supplies are dispatched throughout the building by a series of vertical and horizontal conveyors supplied by Lamson Corp. The conveyors include a main vertical conveyor connecting 46 floors of the building, an express vertical conveyor from the shipping and receiving dock to the mail room on the 12th floor, and a horizontal conveyor system which links the vertical conveyors with mail and supply room workstations. A Lamson electromechanical routing system is used on the vertical conveyors and provides control of routing to the various floors. However, since the electromechanical address system is attached permanently to the vertical conveyor carriers, it could not be used to control selective dispatching to several stations on the 12th floor. These stations are selected by a Maitrol magnetic address system.

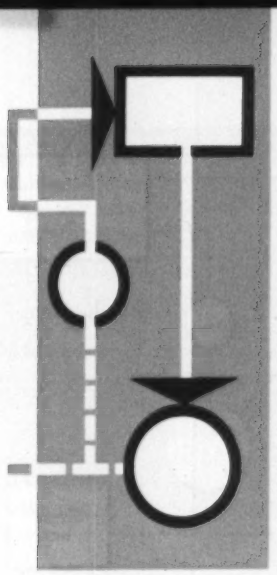
Each hamper, *Fig.* 3, used in the system is provided with metal plates on two sides to receive the magnetic address of the address write stations. An operator in the 12th floor mail room turns a selector dial to address a mail hamper. The coded address is automatically impressed on the hamper by magnetizing selected metal plates on the side of the hamper as the hamper is conveyed along the horizontal conveyor to a vertical one.

At the transfer point to a vertical conveyor, the magnetized address on the hamper is sensed by a Maitrol address reader. Signals generated are used to automatically actuate a floor selector drum of the electromechanical routing system, and when an empty conveyor carrier arrives, the address is set into fingers on the carrier. The procedure is reversed for hampers coming to the 12th floor. In this case, the electromechanical sensor reads the address fingers on the conveyor carrier and transmits the signals to an address writer which magnetizes the plates on the side of the hamper in the proper station code.

To be compatible with the 12-finger electromechanical system of the vertical conveyors, the magnetic address system uses an array of 12 plates on the side of each hamper. In this case, each plate is used to give a simple *Go-No-Go* reading that can be translated to trip or not trip a mechanical finger on the conveyor control system. In a completely magnetic system using binary coded addresses, both vertical floor destination and horizontal station destination could be handled automatically with only 6 or 7 address plates on the hampers. The basic design of a magnetic control system eliminates rubbing, brushing, or moving parts in addressing or reading and is unaffected by dirt, grease, light, ordinary temperatures, or electrical interference. Of major importance is the fact that no wiring is required between stations since the magnetic memory tabs carry the necessary intelligence from point to point.

Part 1

COMPARING ACTUAL POSITIONS TO COMMANDS



ELEMENTS OF POSITIONING CONTROLS

Selection of a machine and a positioning control system to meet a specific manufacturing need requires familiarity with the characteristics of various control systems and factors affecting their application. In this first part of a two-part article, the author begins a discussion of the characteristics of data input, position repeatback, amplifier, and controlled drive elements and their relationships to requirements of a process.

By **JAMES R. WALKER**, Research Director, Gemco Electric Co., Detroit, Mich.

ECONOMIC PRESSURES for higher output per manhour and greater uniformity of product have been important factors in the evolution of high production machines capable of cyclically performing complex and varied operations on materials of many types. This evolution has been witnessed by the substitution of pneumatic, hydraulic, or electric actuating mechanisms for earlier hand cranks and levers as the basic machines have been modernized and their operation has become less dependent upon operator manipulation. Processing requirements of products in this age of advancing sophistication have further made it necessary to extend machine accuracy requirements into a range of values that seemed idealistic a few years ago.

Performance of machine functions, in a manner to meet these economic pressures and processing requirements, involves automatic operation of machine actuators and measurement of resultant machine member positions to an accuracy of four decimal places in many cases. Designers of each machine must employ means to appropriately position its movable members and reflect back to the machine logic control system a quantity proportional to member position with respect to a given reference point. Occasionally designers have based their choice of position control systems simply on expediency, availability, and simplicity. However, a study of machine characteristics functionally related to those of its position and data control system shows that it is more important for the choice of a system to be based on attainable accuracy, repeatability, reliability, and compatibility with machine components and environment.

Typical requirements for various types of manufacturing equipment are shown in TABLE 1. Consideration of data of this type indicates that relatively coarse positioning accuracy and repeatability can be tolerated in equipment such as cutoff presses, paper trimmers, many handling mechanisms, arc cutting machines, and tube bending machines. Many present positioning and data repeatback systems can satisfactorily meet the needs of such equipment with regard to both accuracy and repeatability. On the other hand, requirements for precision machines indicate a near inadequacy of present systems. Particularly is this true for machining of components for high speed aircraft and missiles.

Thus, the intended purpose for a given machine

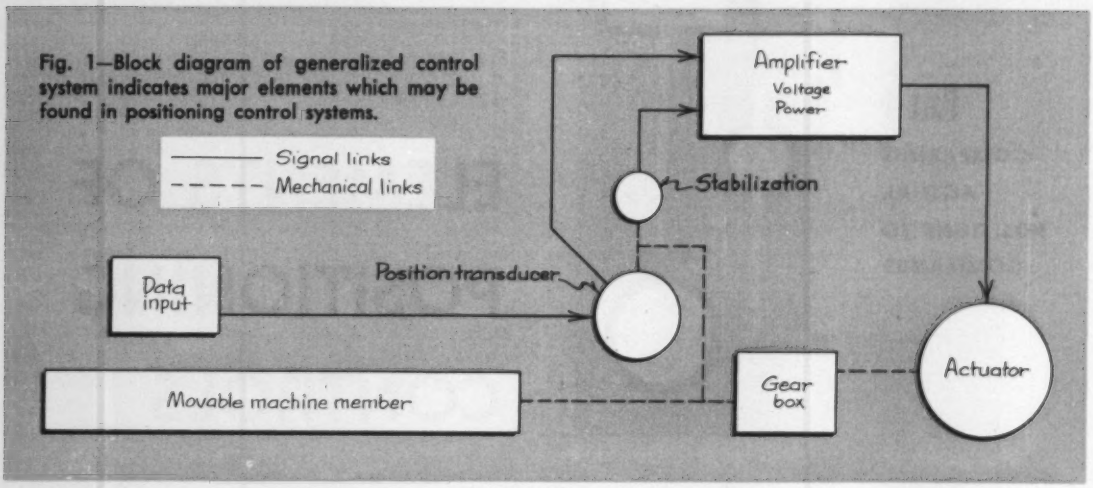


Fig. 1—Block diagram of generalized control system indicates major elements which may be found in positioning control systems.

will be the first factor in determining the type of control system employed, i.e., whether it is to be used for a tool room machine operated in a controlled environment, a tube bending machine operated in a service garage, a selective die and cut-off machine for a big production plant, or a blending and mixing system to be operated in an outside location with widely varying environment. After the environmental requirements have been assessed, it is then necessary to consider the degree of required accuracy and repeatability afforded by a projected control system. Then the final choice of control system for a specific machine application depends upon its reliability characteristics.

These control system considerations—environmental dependency, accuracy, repeatability, and reliability—are common in varying degree to all machine applications. The principal factors in choosing a control system for one machine or another will lie in the repeatability or accuracy requirements. As the required accuracy becomes greater, it is to be noted that the complexity and extent of equipment necessary to attain this greater accuracy increases many fold.

Generalized Control System

The degree of positioning accuracy achieved by positioned machine members is directly related to the characteristics of the principal system components responsible for their control; these are data input, position repeatback, amplifier, and controlled drive elements. The dependency attached to each one of these components for over-all machine accuracy and dependability can be understood from a consideration of the characteristics of each in greater detail.

As a basis of common understanding for evaluation of machine control system requirements, it is possible to represent such a system by a simple block diagram similar to that shown in *Fig.* 1. This system contains a data input device, consisting of either a mechanical or an electrical means, arranged to provide an electrical signal to the input section of an electromechanical transducer. As used in the control scheme shown, a mechanical input to this transducer is provided by the controlled member of the mechanical system. The error signal corresponding to the difference between the data input and the mechanical position of the controlled member exists as an output to the amplifier block. Appropriate amplification dictated by system accuracy and repeatability requirements provides excitation for the machine control actuator. Motion of the actuator shaft is converted to appropriate machine position by means of gears, or combinations of clutches and counter rotating shafts, and lead screws. Other systems might use hydraulic or pneumatic transducers, amplifiers and/or linear actuators. A second or inner control loop is used to achieve dynamic stabilization of positioned machine members and is necessitated by their inertial characteristics.

Position Transducers

In order that a machine member can be positioned with an acceptable accuracy for any given set of requirements, it is first necessary to establish the extent of the backlash or deadband region for the positioning mechanism used with this member. The measuring transducer or repeatback element and its attendant deadband characteristics, when employed with the machine member, will determine the amount of deadband or backlash to be included in the control system loop. Thus, for all types of repeatback devices whose mechanical input is provided by rotating a shaft, an important consideration is the means of coupling this device to the positioned machine member.

In most cases, a gear train is required to reduce member travel to one revolution or less of the transducer shaft. It is necessary to determine whether any backlash in this train is comparable, when expressed as an arc of the transducer shaft, to the positional accuracy requirement of the ma-

chine member. Satisfactory results on the basis of this comparison rest upon the assumption that the electrical and mechanical error factors for the transducer are small (1/10 or less) compared with the machine member positioning tolerances.

If a transducer would have to derive its mechanical input through a gear train used for transmission of power to position a machine member, and this gear train includes a backlash factor large in comparison with required machine tolerance, a type of transducer not employing a mechanical input shaft should be considered. For those machines where it is impossible to utilize such other types of transducers, it is necessary to provide a separate rack and gear train, both exhibiting minimal backlash, to position the mechanical input shaft of the associated transducer.

Several common transducers illustrated in *Fig.* 2 are the resolver, synchro, inductive plate, optical grating, toothed magnetic drum, digital contactor, digital magnetic drum, magnetic pin, magnetic tooth, and multi-turn potentiometer. Typical circuits which may be used with these transducers are indicated in *Fig.* 3.

Certain other machine characteristics influence greatly the choice of a positional transducer for use on a specific machine. Among these factors may be listed the following:

1. The controlled member may have undesired movement with respect to the machine base in a direction transverse

TABLE 1—Typical Machines with Positioning Systems

Machine	Data Storage Medium	Number of Controlled Axes	Repeatability	Total Cycling Time	Control Components
Asphalt batching	Manual tap switches	6	±0.1% Of full scale reading	2 Minutes	Resolvers, transistor amplifiers, relays
Seat cushion spring welding	Manual tap switches	5	±0.015 Inch	35 Seconds	Resolvers, transistors, relays, controlled rectifiers, dc motor
Armature insulator assembly	Card	3	±0.005 Inch	72 Seconds	Resolvers, transistors, relays, controlled rectifiers, dc motor
Drilling	Tape	2	±0.001 Inch	Depends on Number of Holes	Potentiometers, tubes, relays, servo valve, hydraulic system
Drilling	Tape	2	±0.001 Inch	Depends on Number of Holes	Potentiometers, transistors, relays, dc motor, digital contactor
Boring	Tape	6	±0.0001 Inch	16 Seconds	Potentiometers, tubes, relays, dc & ac motors, magnetic tooth transducer
Tube bending	Card	5	±0.010 Inch	35 Seconds	Synchros, tubes, relays, hydraulic system
Frame welding	Tape	2	±0.010 Inch	Variable	Synchros, tubes, relays, hydraulic system
Contour	Tape	3	±0.001 Inch	Variable	Synchros, tubes, relays, hydraulic system

to the controlled axis of travel. For example, if the slide and table ways wear non-uniformly, variation in transverse position of a point on the table of a machine may cause a variation in the air gap of a magnetic slot transducer system. This same machine problem results in misalignment of optical transducer systems if the table motion becomes crablike after wear of the slides has progressed.

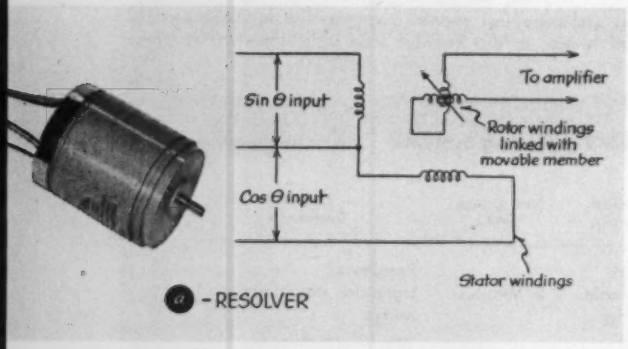
2. Non-data components of both cyclic and random nature may be superimposed upon the true data due to machine induced vibrations of the transducer.

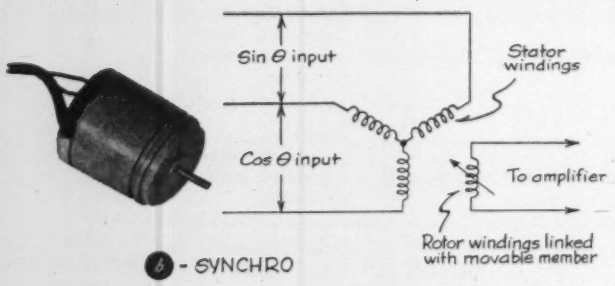
3. Contaminants may interfere with transducer performance. For example, iron dust may enter the air gap region of magnetic lobe type transducers, or the optical system for an optical transducer may be partially obscured.

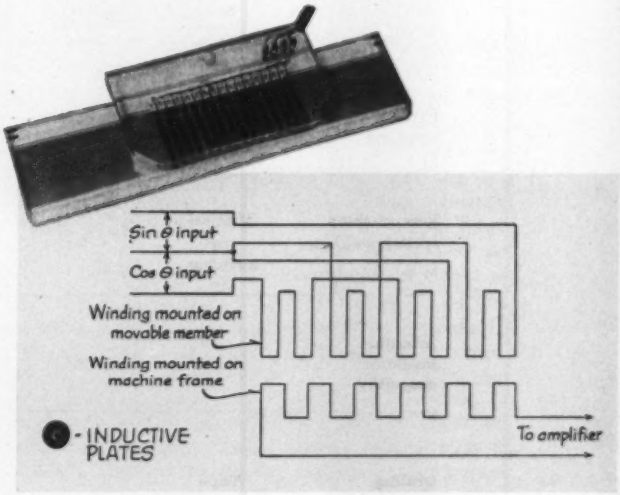
4. Brush position may vary with respect to its segmental disc on a digital drum type transducer due to machine vibration. The result of this variation is the existence of false pulses of data input which ultimately cause improper machine positioning.

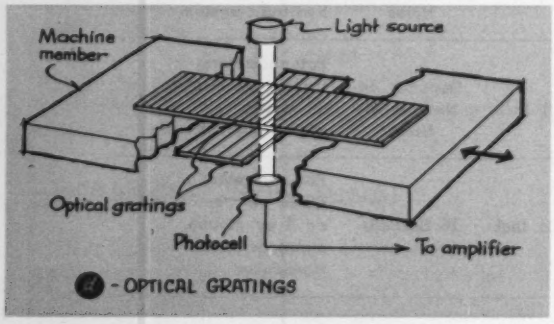
The individual mechanical and electrical charac-

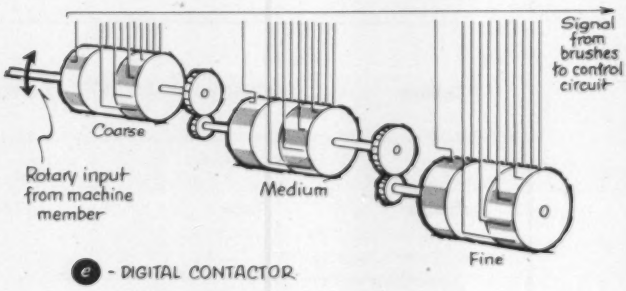
Fig. 2—Various types of transducers can be used to repeat back the position of a movable machine member. Some of these elements require the rotation of a shaft in precise relationship to linear travel of the member, see *a*, *b*, *e*, *f*, *g*, and *k*. Others mount part of the transducer on the movable member and part on the machine frame, see *c*, *d*, *h*, and *j*.

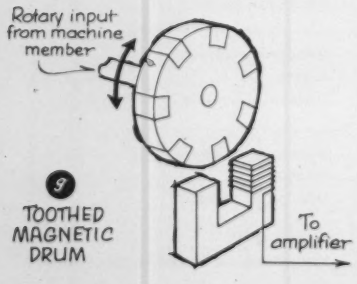


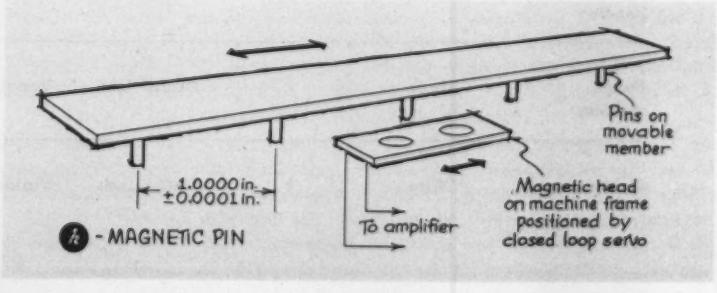











Pins on movable member
1.0000 in. ±0.0001 in.
Magnetic head on machine frame positioned by closed loop servo
To amplifier
k - MAGNETIC PIN

teristics of transducers being employed in present day machines can be considered with regard to inherent accuracy, dispersion factors, repeatability, stability, and reliability. A proper evaluation of these factors leads machine designers to employ transducers in machine control systems on the basis of their functional merit.

Resolvers: Among the several shaft type mechanical input transducers available, the resolver is perhaps the most versatile because of the many possibilities available for electrical input to it. A representative resolver used in machine control systems and a simplified circuit employed for supplying electrical data input to this device are shown in *Fig.* 2*a* and 3*a*. A transformer employing a toroidal core configuration is suitably tapped to provide voltages proportional to the sines of various angles and other voltages proportional to the cosines of these angles. The angle is the equivalent of the desired mechanical displacement.

Positioning is controlled with the resolver for any coherent set of sine and cosine data inputs. Mechanical positioning of the data tap switch to a chosen digital position is provided either manually or from a tape controlled stepping relay. The existence of an error voltage at the resolver output is determined by the difference in commanded position of the resolver shaft and its actual position. Motion of the controlled machine member rotates the resolver shaft until a minimum voltage exists across the rotor output terminals.

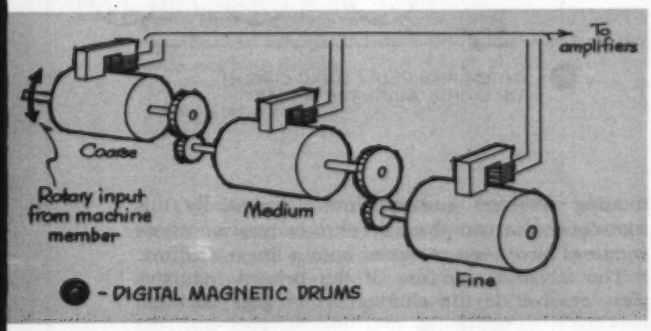
As used in the given control system, the resolver shaft is connected to the positioned machine member inside a closed control loop where it will be moved in a direction to reduce its error voltage essentially to zero. This minimal output will in general denote the exact machine position given by the input data.

The degree of accuracy attained by use of such a resolver system is influenced principally by inherent manufacturing tolerances and errors derived from harmonics generated within the resolver due to unequal transformer tap impedance as the data transformer taps are inserted for various data angles. Typical error for a resolver exhibiting the most acceptable positioning accuracy of any commercial type now available is shown in TABLE 2.

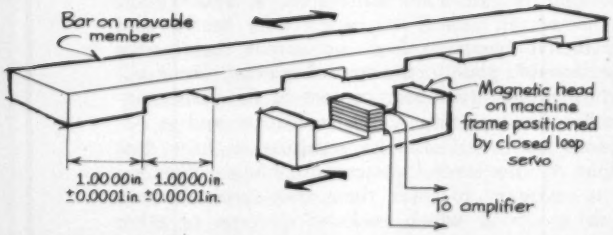
The electrical diagram of a resolver in *Fig.* 3*a* discloses that the data input or stator winding of the resolver employs a double winding and is disposed in the manner of a two-phase motor stator such as that used with a two-phase induction motor. One point of interest in the electrical characteristic of this device is that the output voltage of the rotor winding varies in a sinusoidal manner with respect to the data readout position. Zero voltage will occur at the readout position corresponding to a chosen data position and a zero voltage will also occur 180 shaft degrees from the chosen position. Thus, it is seen that the possibility for a false data region exists and that consideration must be given to this fact during design of the control system. In order to eliminate the possibility for false positioning of the machine member, the designer chooses a gear ratio for use between the machine member and its transducer which will only permit 180 mechanical degrees of transducer shaft rotation during full member travel.

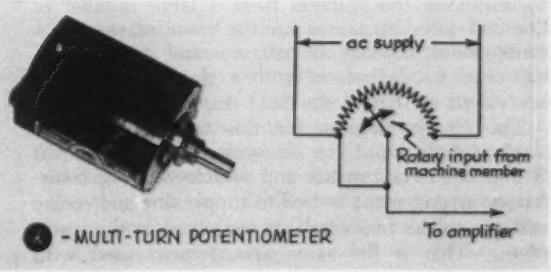
Synchros: Unlike the resolver, a synchro stator utilizes a three-phase winding configuration while the rotor may either use a single or a three-phase winding. Illustrated in *Fig.* 2*b* is a typical synchro similar to that used in machine control systems. The electrical circuit, including a data input transformer and a synchro, is indicated by *Fig.* 3*a*, which is the same circuit referred to earlier with digital input transformers used for both resolvers and synchros. The sine and cosine voltages from the digital transformer are supplied to two of the three-phase windings of the synchro in a manner similar to that for the two-phase synchro or resolver. In fact, the two types of units are often labeled synchros with no distinction being made that the two-phase unit is a resolver.

The three-phase synchro and two-phase resolver

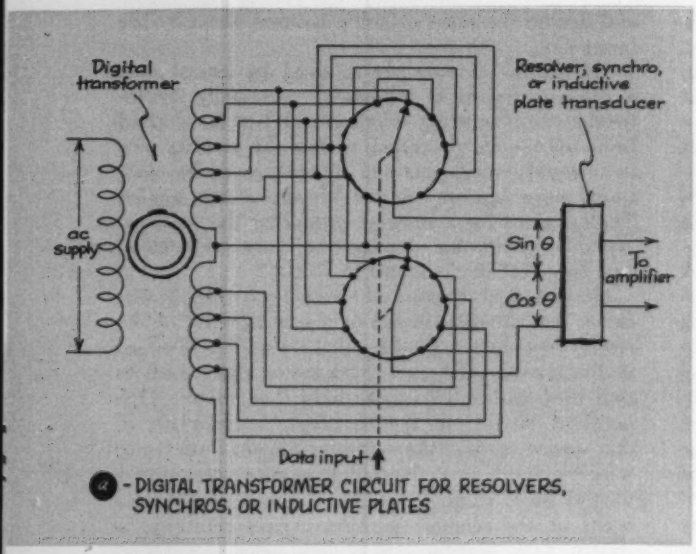


i - DIGITAL MAGNETIC DRUMS

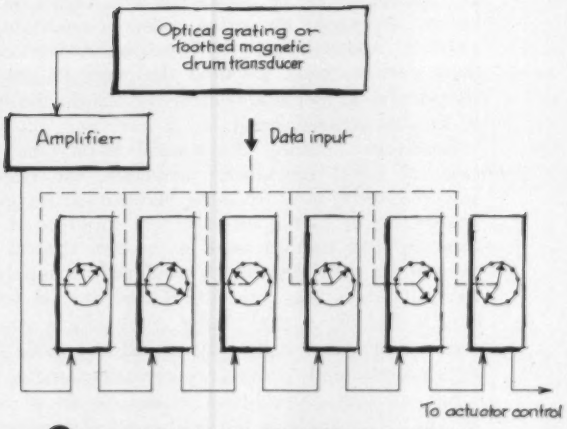

Bar on movable member
Magnetic head on machine frame positioned by closed loop servo
1.0000in. ±0.0001in.
1.0000in. ±0.0001in.
To amplifier
j - MAGNETIC TOOTH



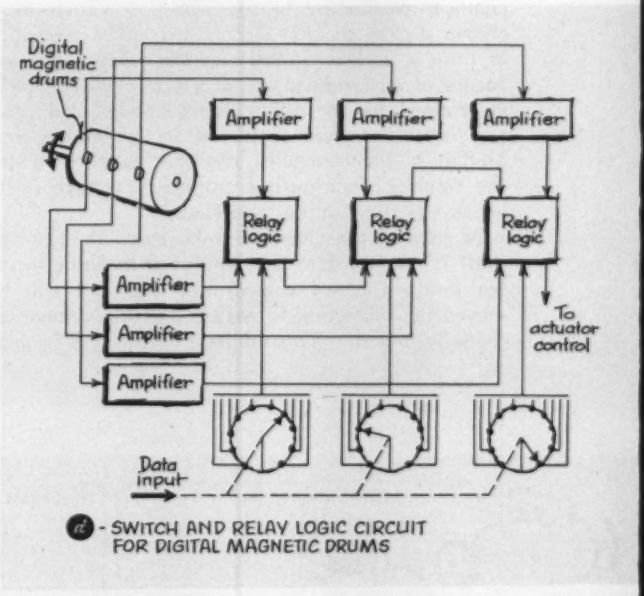
k - MULTI-TURN POTENTIOMETER



a - DIGITAL TRANSFORMER CIRCUIT FOR RESOLVERS, SYNCHROS, OR INDUCTIVE PLATES



b - TAP SWITCH CIRCUIT FOR OPTICAL GRATINGS OR TOOTHED MAGNETIC DRUMS



c - SWITCH AND RELAY LOGIC CIRCUIT FOR DIGITAL MAGNETIC DRUMS

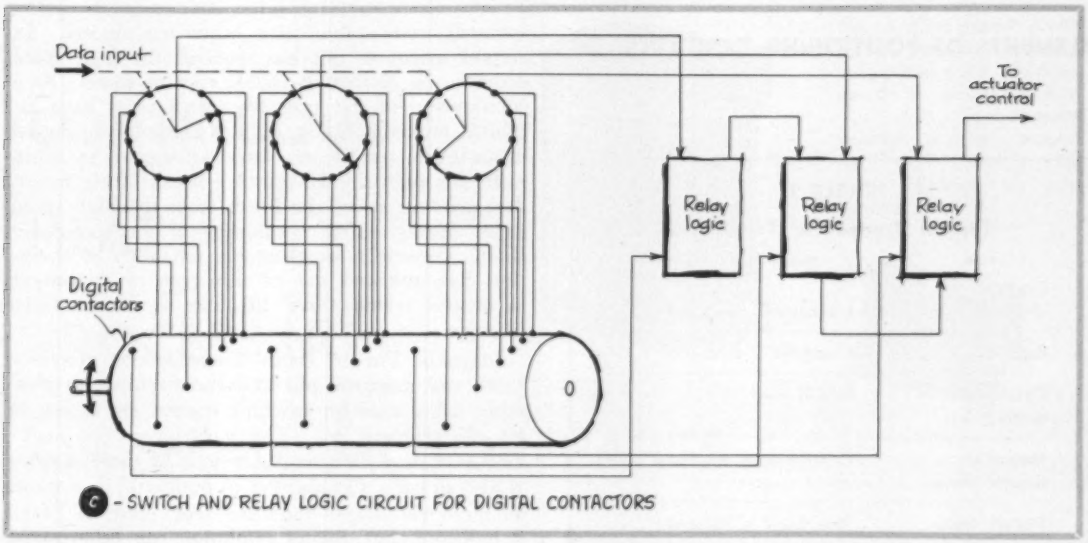
are constructed in similar fashion, with accuracy and repeatability being determined by the impedance unbalance existing between the sine and cosine sections of the digital transformer. Use of a synchro exhibiting stator winding impedances which are large, in comparison to the internal impedance of the digital transformer, minimizes system error arising from induced harmonic currents due to unbalanced winding impedances in a digital transformer. The data shown in TABLE 2 is the smallest deviation to be expected with a synchro exhibiting least possible error.

Inductive Plates: It has been pointed out that the general effect of backlash in a transmission link between a transducer and a positioned machine member is to decrease the over-all positioning accuracy of the control loop. Since it is not possible in some machines to reduce the backlash of such transmissions, it is then necessary to utilize transducers not employing a rotatable shaft for mechanical data input.

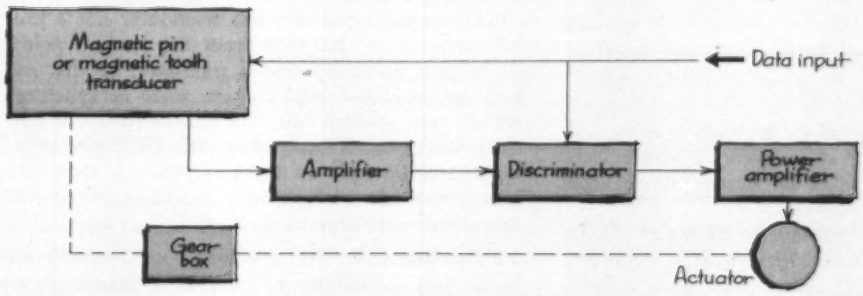
An example of such a transducer is the device using inductive plates as shown in *Fig.* 2c. This device includes an etched stator winding which has been projected upon a dimensionally stable nonconducting surface by a photographic process. The rotor associated with this transducer is constructed in a like manner. Variations in inductor displacement are averaged over a large number of inductors by summing the voltages from a large number of like coil sides contained on the rotor plate. As a consequence, the reproduced rotor and stator inductors need not be printed with a positional accuracy equivalent to that of the final transducer.

The circuit diagram for this transducer and a single decade input for use with it are also shown in *Fig.* 3a. A tap switch and double-winding transformer arrangement is used to supply sine and cosine voltages to the two windings contained in the stator plate. This is the same arrangement used with rotating resolvers and synchros. Essentially this transducer is a two-phase synchro or resolver whose windings have been projected onto a linear medium.

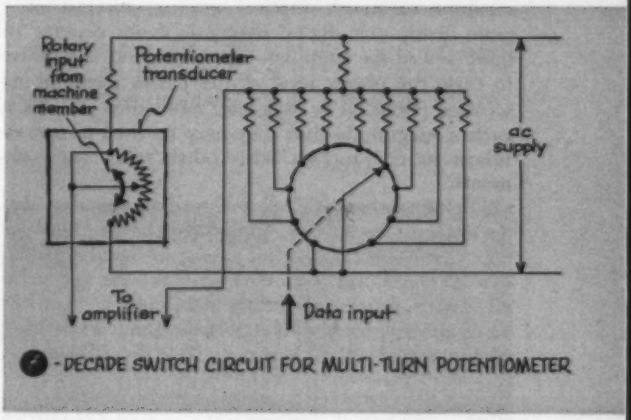
The advantage in use of the printed inductive plate resolver is the elimination of gear backlash between the positioned machine member and the movable element of the transducer. A disadvantage in use of this unit is the necessity for brushes and conductive bands to feed the output signal from the movable plate to the control system. Some difficulty results from poor contact in the brush-conductive band portion of the transducer and is evidenced by electrical noise resulting in false data input to the control system amplifiers. Further, it is necessary to cover these transducer elements with a shroud which excludes all iron or other ferromagnetic material from proximity to their plate areas.



c - SWITCH AND RELAY LOGIC CIRCUIT FOR DIGITAL CONTACTORS



e - AMPLIFIER AND DISCRIMINATOR CIRCUITS FOR MAGNETIC PIN AND MAGNETIC TOOTH TRANSDUCERS



f - DECADE SWITCH CIRCUIT FOR MULTI-TURN POTENTIOMETER

Fig. 3—Typical application circuits use the transducer elements shown in *Fig.* 2. These circuits require data input from an operator or data storage device and an appropriate linkage between the transducer and movable machine member. The output of the circuits goes to an amplifier and/or actuator control to regulate the positioning action of an actuator.

The accuracy of the printed inductive plate resolver is equivalent to that of rotary shaft synchros. Dispersion of data due to generation of harmonics caused by unbalanced impedances in the data transformer is also encountered with the inductive plate resolver. A related type of device is that using bifilar windings on a rod and sensing sleeve.

Pulse Devices: A general class of transducer devices used in machine control systems for measurement and position repeatback utilizes pulse producing transducer elements to convert displacement into pulses representing units of displacement. Transducer units included in this class are optical gratings, toothed magnetic drums, digital contactors, and digital magnetic drums.

Commercial units representative of the pulse devices being employed on machine control systems are shown in *Fig.* 2*d*, 2*e*, 2*f*, and 2*g*. Typical circuits are indicated in *Fig.* 3*b*, 3c, and 3*d*. Functioning of the pulse or digital transducers listed can be considered of two types: 1. Transducers which require counting of least dimension units for machine member positional measurement. An optical grating with a photocell and a toothed magnetic drum with a reluctance pickoff are examples of pulse counting systems. 2. Transducers which use logic networks for readout of machine member position. A digital contactor using a geared sequence of print-

TABLE 2

Typical Transducer Tolerances

Type	Manufacturer's tolerance
Synchro (3-phase)	4 minutes of shaft arc
Resolver	4 minutes of shaft arc
Optical grating	0.00001 inch
Magnetic toothed drum	15 minutes of shaft arc
Digital drum	35 minutes of shaft arc
Magnetic pin or tooth	0.00005 inch

ed circuit drums contacted by multiple brushes and a sequence of magnetic drum sections with reluctance pickoffs are examples of systems using logic networks to read out positions.

Accuracies for pulse transducers shown in TABLE 2 are comparable to those for synchros, resolvers, or inductive plates. However, as is the case with the inductive plate devices, optical gratings have an advantage in that they do not require a gear drive between the transducer and the positioned machine member. Optical grating, toothed magnetic drum, and digital magnetic drum systems require use of an amplifier. Amplification is required to raise the power level of the pulses from the associated photocell or magnetic reluctance pickoffs to such a magnitude that they may be used to operate relays in conjunction with other relay logic elements.

Digital contactors display the advantage that they do not require any auxiliary relay or amplifier circuit. However, the digital contactor has the distinct disadvantage that it must employ at least one printed circuit drum and brush combination in which the drum rotates at 1000 times the input shaft speed of the transducer if the unit is to have positional accuracy comparable with other transducers. In certain machines this has required the high speed drum to be rotated at 16,000 rpm or more. As a consequence of this operation, such units have exhibited unacceptably short life. Designers of digital drum-brush transducers have attempted to minimize this difficulty by use of a brush lifting means designed to remove the brush from the high speed drum during coarse positioning of the transducer shaft. Generally, unacceptable reliability of operation has attended use of this type of transducer in control systems involving four significant digits or more.

Magnetic Pin or Tooth Transducers: Magnetic tooth and magnetic pin transducer systems as presently being used for machine control are shown in *Fig. 2h, 2j,* and *3e.* The auxiliary amplifier circuit that must be used with both of these systems is also shown. Comparison of positional resolutions for these transducers and other types given in TABLE 2 indicates that greater resolution can be expected from magnetic pin or tooth units.

The magnetic pin or tooth transducer has a useful range of ±0.150 inch from the readout point. Thus, it is necessary that a transducer of this nature be employed with others such as synchros, which can position the machine member within the useful ±0.150-inch range of the high speed, high resolution pin or tooth system. A switching means must then be provided to successively switch from one transducer to another.

Potentiometers: Multiple turn potentiometers are being used as position transducers in machine control systems that do not require greater accuracy than the positional equivalent of ±0.001 inch. Shown in *Fig. 2k* and *3f,* is such a transducer and an electrical circuit commonly employed for inserting digital data into the transducer system. An obvious disadvantage of the potentiometer is unreliability related to frictional wear in the slide wire arrangement characteristic of its fundamental design.

The concluding part of this article will appear in a succeeding issue. In it, types of amplifiers and their characteristics will be discussed along with amplifier-actuator system combinations. Supplemental control factors such as switching of transducers, anticipation of command points, maintenance of constant torque, and buffer data storage will also be considered. In conclusion, the author will then comment on cost factors and general selection policy.

can we help?

It has been pointedly mentioned at various times that in engineering automated systems new as well as old techniques and devices may prove extremely useful. Practical results require the investigation of all available equipment that can contribute to the effective development of suitable automatic lines. Information on such equipment is presented in various departments of the magazine each month as useful data become available. To aid in obtaining detailed data for further evaluation a post card is included on page 19. Take advantage of this service. The Editors will be glad to help in this or any other way.

CONTINUOUS HEAT PROCESSING OF SMALL MOTOR PARTS

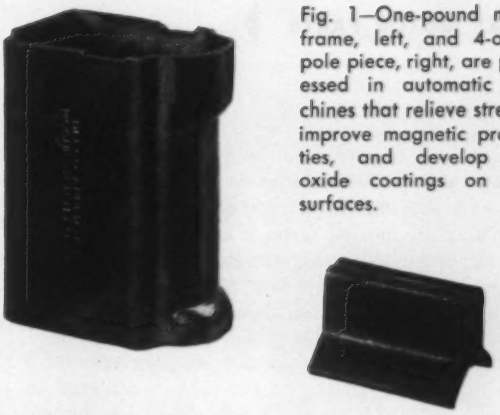


Fig. 1—One-pound motor frame, left, and 4-ounce pole piece, right, are processed in automatic machines that relieve stresses, improve magnetic properties, and develop thin oxide coatings on part surfaces.

By **W. B. TROUPE,** Asst. Manager, General Industry Div., Selas Corp. of America, Dresher, Pa.

ONE OF THE production problems faced by an automotive parts manufacturer in introducing a new product involved the setting up of facilities for efficient, continuous heat processing of piece parts. The product is an electric motor for actuating automobile windshield wipers, automatic windows, and seat positioners. Specifically, motor frames and pole pieces, *Fig.* 1, must be processed after stamping so as to relieve stresses, improve magnetic properties, and produce a controlled amount of surface oxidation that facilitates paint adherence.

To secure these results, the equipment was required to heat and cool the parts at closely controlled rates and quench them. Additionally, it had to be integrated with existing stamping presses and had to transfer the parts by conveyor from the quenching solution to following operations.

Both the frames and pole pieces are made of SAE 1010 hot rolled steel, but their sizes and shapes differ to such a degree that to process both types in a single system would have required a complex combination of heat processing equipment. Therefore, separate facilities were provided for each piece part by the equipment supplier, Selas Corp. of America.

Motor frames are processed by two Gradiation machines, of the type shown in *Fig.* 2, operating in parallel. Parts are delivered to a machine operator

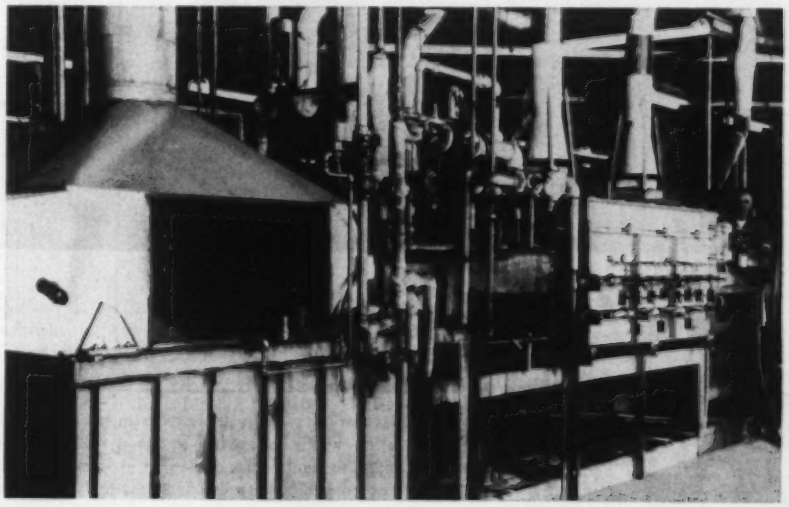


Fig. 2 — Automatic radiant heating machine processes 750 motor frames per hour. Operator at extreme right places workpieces at spaced intervals on a wire mesh belt. As they proceed through machine on the belt, parts are sequentially annealed, cooled through a critical range, and quenched in rust inhibiting solution. Quenched parts are transferred from tank, left, to next operation on conveyor belt.

from a feed hopper. To load the machines, the operator places the motor frames in an upright position on a wire mesh conveyor belt for each unit.

As they are carried through each machine by the belt, the frames first pass a radiant heating chamber where Duradiant burners heat the parts. With burners in the side walls and above and below the belt, annealing temperature is attained in 240 seconds.

This high speed heating and the formation of a thin, tight oxide coating on the parts is achieved by a combination of controlled combustion, high thermal head, and proximity of the radiant burners to the parts. A combustion controller takes natural gas from a low pressure line, draws air from the room, and mixes the two in a preset ratio. The mixture is compressed to several psi and delivered to the burners.

The burning of this closely controlled gas-air mixture against special cup-shaped refractory surfaces creates radiant heat which is beamed directly to the workpieces. Since combustion is completed entirely within each refractory cup, there is no impingement of flame upon the work.

After annealing, the parts continue on the belt through a water-jacketed cooling chamber for a controlled cooling cycle of about 120 seconds. During this period, the temperature of the parts is reduced from 1500 to 1200 F. Within this critical range, cooling must be carried out with exactness to avoid hardening the parts.

Following heating and controlled cooling, the frames drop from the belt into a quench tank containing a water and rust inhibitor solution. After a quenching time of 60 seconds, the parts are automatically transferred from the quench tank to a sizing station by a conveyor. Temperature of the parts leaving the quench solution is about 300 F. Output of each machine is 750 frames per hour.

Pole pieces are formed from flat stock into the desired configuration by a series of cutoff, folding, and coining operations. They are then conveyed to the bowl of a vibratory feeder for delivery in an oriented fashion to the wire mesh belt of another heat processing machine, *Fig.* 3. Treatment of pole pieces in this machine is similar to that received by motor frames. Output is approximately 2500 pole pieces per hour.

The three heat processing machines are operated on a 24-hour, 7-day per week basis. With only limited floor space available for the process, the space economy effected with the setups was an important factor. Heat losses to the room are minimized by the design of the radiant burners.

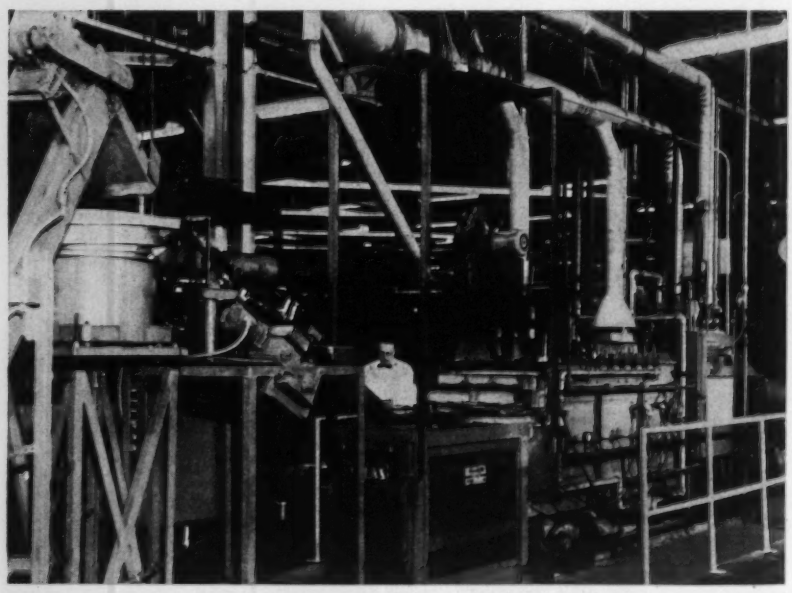


Fig. 3—Pole pieces are fed automatically to this continuous heat processing machine by vibratory feeder, left. Output of machine is approximately 2500 pieces per hour.

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Of fairly recent origin, tape preparation centers are an additional consideration facing the management investigating the numerical control field. What services are offered by such centers? What are the advantages? Are centers a factor in determining the economic feasibility of using numerically controlled machine tools?

Fig. 1—Pictured facilities support sizable numerically controlled operation primarily employing contouring type machines. Expense of such facilities, along with specialized knowledge accumulated by use, suggests the advantages to be gained by an outside company who draws upon them for service.

TAPE PREPARATION CENTERS PROVIDE

ANSWERS TO NUMERICAL CONTROL

By **ROBERT C. WILBURN,** Manager, Boeing Applied Computing Services, Wichita, Kans.

IN OUR ECONOMIC system, a strong need for technical services is certain to attract the interest of those capable of providing such services. Special aspects of numerically controlled machine tools have led, rather sooner than later, to the formation of various types of "service centers." Such centers range from the lone consultant, through the unique job shops built around a single numerically controlled machine tool, to truly large-scale centers which provide such services as drawing conversion, programming, computing, tape preparation, tool design and fabrication, part fabrication, personnel training, and general consultation.

Boeing Applied Computing Services (BACS), *Fig.* 1, is an example of the latter type center. In dealing with people vitally interested in one of the several

areas of numerical control, BACS personnel have noted certain recurring questions. The purpose of this article is to review those questions most frequently asked and present answers based upon Boeing Airplane Co.'s four years of experience in the numerical control field and background acquired in BACS. These questions primarily apply to profiling and continuous path equipment and generally are not applicable to point-to-point control systems used in drill presses or similar machine tools.

To avoid confusion with programs used by other centers, it probably should be mentioned at the outset that BACS employs a special numerical control computer program identified as WALDO (Wichita Automatic Linear Data Output). The program is unique in that it offers true two and three-dimensional machine programming.

Why have tape preparation centers come into existence?

They have come into being because of the high cost of data handling equipment, problems of maintaining the equipment, need for qualified personnel, and lack of general experience. It is not a practical investment for a single company to buy expensive equipment (costing about a quarter of a million dollars) that might be utilized only 15 per cent of the time. However, if services are obtained from a tape preparation center, a customer is buying only the use of the equipment as it pertains to his particular job. Thus he is paying just a small portion of the entire cost, making it more practical insofar as his own application is concerned. The research, development, and updating of an efficient computer program also is expensive since the supporting personnel represent a very high level of technical skills. The machines, along with skilled personnel, must perform on a full-time basis for efficiency and economy. Another important point is that by utilizing a tape center, the smaller customer can take advantage of experiences accumulated over many, many jobs, rather than just his own work.

What services should a tape preparation center offer?

Industry is faced with problems involving drawing conversion, part programming, computing, preparation and verification of the tape, tool design, and tools and parts fabrication. Consulting and training services also enter the picture. All companies are not faced with the entire range of problems. For instance, a customer may desire to do his own part programming, tool design, and tools and parts fabrication. In this instance, however, the company must first receive training for its personnel.

What type of training is required to utilize tape preparation and related services?

To management, this is a very complex question, and in order to make a good decision one should first learn something of numerical control. The individual making the choice, usually from the top management level, would need some indoctrination in numerical control to gain the knowledge for making the right decision. A tape preparation center can offer consultation-type service and recommend what type of training is needed. The consultant can suggest when it will be economical for a customer to train his own programmers or when he should subscribe to the whole service. If a customer has determined that portions of the service, such as the computing and tape processing, are all that he wants, the consultant can then recommend applicable training courses. In summary, a tape preparation center can be a source for both service and training, with a customer obtaining the advantage of superior technical ability and technical improvements available only through experience.

If a company were in the process of evaluating whether or not it should use the services of a tape preparation center, how would it determine if this would be advantageous?

One would first have to consider these qualifying factors: 1. Whether the company is just starting in numerical control or whether it has been utilizing this type of equipment for some time. 2. The type and quantity of machine tools for which it is making control tapes. 3. The quantity of control tapes to be made in a given period of time. Worth considering here is that the actual development cost of a working computer program for continuous path and multiple positioning methods involves some 20 man-years of effort. One must consider this in flow

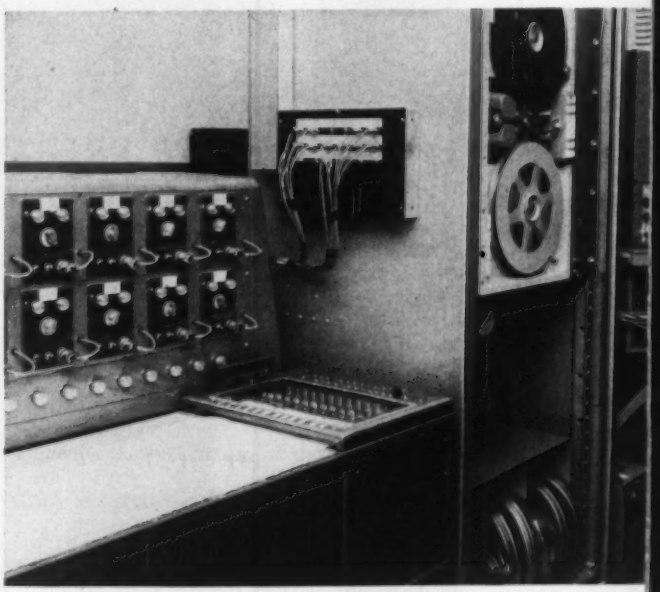


Fig. 2—Magnetic tape verification unit is valuable adjunct to tape preparation center. For example, this unit can be used to check a reel of magnetic tape to verify that the entire length of each channel on the tape can accept a magnetic charge. Signal strength of a completed tape can also be checked.

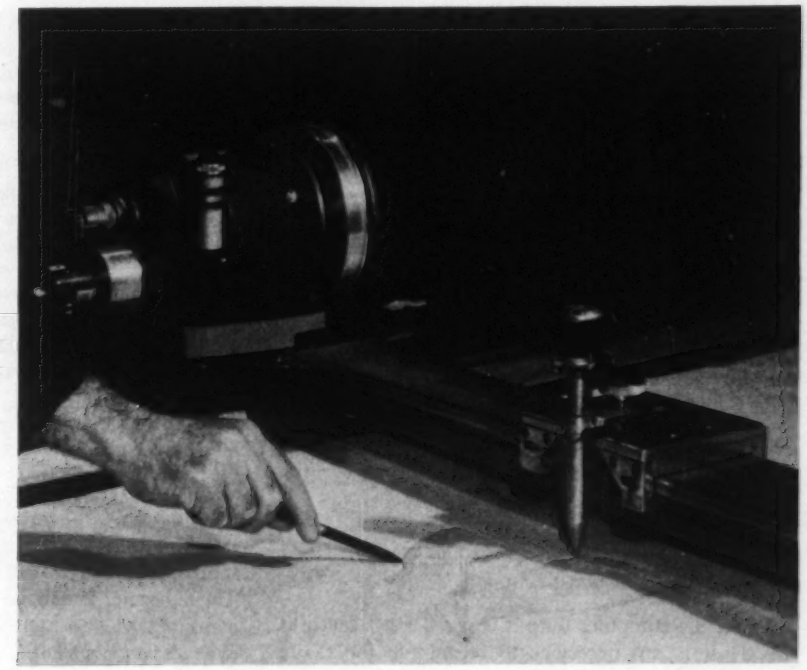


Fig. 3—Verification phase of tape preparation at BACS includes use of special plotting machine that can draw path of cutter center lines which have been recorded as signals on a control tape. Plan view, side view, and end view can all be obtained by controlling which two axes are used as inputs to the verifier. Gross errors in recording are readily identified.

time, i.e., ten people over a two-year period would indicate a minimum of two years to get started. In addition to personnel salaries, the tape preparation and verification facilities, *Fig.* 2 and 3, aside from rental of the computer, could involve considerable additional costs. In order to show the break-even point one would have to ascertain the number of tapes that could be amortized over such an extensive program.

If a tape preparation center is used, in what form would engineering data have to be presented for the most efficient use?

For the most efficient processing, the drawings should be dimensioned in co-ordinate form. But, if the drawings are not in this form, but are completely dimensioned, they can be converted by the tape preparation center. The closer one conforms to co-ordinate dimensioning methods (simulating machine axis movement) the less the finished control tapes will cost. This will also reduce the lead time for the finished product.

What about flow time for service at a center?

Basically this question falls in two categories: One, assume the center does the part programming, tape preparation, tape verification or tape proving; second, consider the customer doing the part programming and merely sending his punched cards or manuscripts to the tape center for processing by the tape preparation machines and computer. The length of time in either case would be governed by complexity of the part involved. If the part required an extreme amount of programming or computer time, then naturally it would take longer than for some simple job requiring only a few hours for part programming and just a few minutes in the computer. On most jobs at BACS with either the customer or center doing the part programming, the tape normally can be prepared, computed, and verified in approximately three days. When estimates are required prior to doing the work, about five to seven days extra flow time are allowed, depending upon complexity of the part.

In what form would the data be returned to the user?

This depends upon the requirement of a customer. Output data can be supplied concerning all phases of the tape preparation process. Briefly, some forms of data which might be required by the customer and can be furnished are: Setup documents, programming sheets, computer output listings, control tape, a plotting of the cutter center path, manufacturing records (a listing of the sequence of operations), and tool drawings as required.

How do I know the machine control tape will be correct?

This can be assured to the customer by the tape preparation center. Relying upon the plotting of the cutter center paths, checking of the manuscript to the computer printout, and using card-to-tape verification, the service center should be able to warrant the tape. A high degree of tape reliability has been attained by these methods, far surpassing any other known method today for efficiency. In the event a tape does not perform satisfactorily at

the customer's plant, then liaison work would be necessary between the tape center and the customer to define the area of error.

How can processing at a tape preparation center be co-ordinated with the customer's tooling?

The customer must furnish to the tape center a description of the holding fixture and special cutters, and a copy of his customary production planning. Mutual support is a necessity when work is in progress at two different facilities.

Will it be possible to change a machine control tape to the latest engineering information or to correct a production tape already in use?

Original output information from the computer can be retained and used to make the new tapes incorporating the changes.

If a tape is damaged in use would a replacement cost the same as the original?

No. If the computer output is saved (it is saved at BACS) it is not necessary to recompute the entire job, and only a fraction of the cost and time would be involved.

What should processing service cost?

Because of the great differences in requirements, policies, etc., a specific answer is not possible. For example, at BACS each individual customer order is appraised by an estimating group and a firm price established. As an answer to the question, perhaps a better guide would be to consider the possible savings and determine whether or not it would be worthwhile to investigate a job in detail. For jobs capable of being performed on numerically controlled machines, an average of 30 per cent efficiency improvement can be expected over conventional means.

Development of efficient computer programs seems to be a source of trouble. When will the ideal program be developed?

Programs for multipositioning, two-dimensional, and three-dimensional work have already been written and, at certain levels of sophistication, are completed and in use. Some of these programs are production-proved over a period of four years, e.g. WALDO. Anyone acquainted with computer programming knows that a successful program must be continuously updated and modified to meet current requirements. Additions or updating of the computer program require very little part programming retraining. The program and the language do not become obsolete but are only continued and modified to include additional capabilities. Efficient computer programs are available that allow one part programmer to program for any type of machine. This deletes the requirement for special programmers for various types of equipment, and the work load flowing through a part programming department falls evenly within the ranks of the programmers.

Can true three-dimensional die-sinking be performed on today's numerically controlled machines?

This represents one of the most fertile areas for the application of numerical controls. In order for this type of work to be economically feasible, however, it must be accomplished with a computer program. The necessary computer programs for this type of work are already written and have been proved in production. The expenditure of time and money to develop such a computer program can only be justified by a tape preparation center.

How can one tell if a part is best suited for numerical control?

The critical points for consideration of numerical control usage include the following: Lead time, handling time, number of tools required, machine setup time, and quantity and consistency of parts. To elaborate, it can be said that numerical control can cut lead and handling time, reduce the number of tools and machine setups (oftentimes only one holding fixture and one setup are needed) and provide a consistency of quality afforded by no other means of production. Because of this consistency, rejections and rework can be cut drastically. It also should be pointed out that right and lefthand parts can be manufactured from the same tape—further reducing tooling requirements. All these factors should be considered relative to a particular part to determine where the saving is evident. In many instances, only a reduction in the number of tools or machine setup time will warrant numerical control usage over conventional means of production.

On what quantity of parts is numerical control practical from a cost standpoint?

There is no set number. Each job has to be considered on the bases of the complexity of the part and number of operations to be performed. On parts having different contours or requiring several milling operations and only one holding fixture, such as dies, cams, templates or prototype parts, one or two parts could be economically machined by numerical control. On complex parts, requiring special cutters or multiple holding fixtures, a quantity of five to ten parts becomes necessary. Additional numbers of parts, therefore, increase the savings as the tooling can be amortized over larger production runs.

Is numerical control adaptable to close-tolerance contours and machining?

The answer here is a very definite "yes." In many cases the only means of transposing equations or other engineering data defining a curve is through a computer. Precise computed data then instruct the machine to hold tolerances required in the engineering information. This eliminates human error in the blending and fairing of the curved surface.

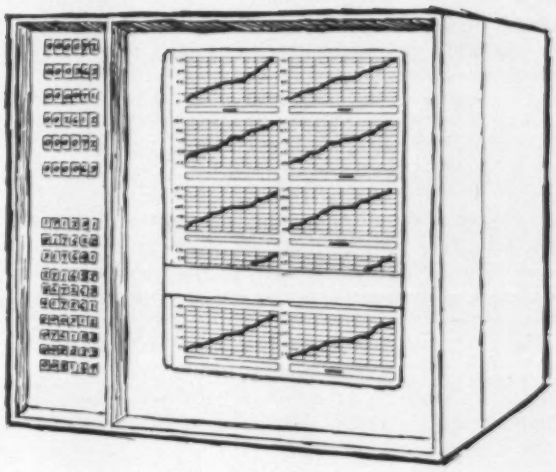


Fig. 1—Recorder is designed to log production data in both digital and graphic form, as suggested in artist's sketch. Typical X-Y recorder technique is used to plot graphic data on a minute-by-minute basis as parts are produced.

IMPROVED CONTROL WITH GRAPHIC RECORDING OF PRODUCTION

By **W. E. VAN HORNE,** President, Keinath Instrument Co., Columbus, Ohio

TYPICALLY, a great deal of effort is routinely put forth to obtain detailed production data. Very frequently machines are equipped with digital counters, and production clerks keep detailed log-sheets showing the numbers of items produced, hour-by-hour. In addition, many types of automatic data accumulation systems have been developed, some capable of accumulating and logging enormous quantities of figures and data.

Unfortunately, many attempts at centralized production data accumulation have foundered because insufficient attention was devoted to the methods by which information was recorded and presented. Overlooked was the fact that the production supervisor or plant manager is a human being who can assimilate only so much data. It does no good to record great quantities of information unless it is in such a form that the man who must use it can easily interpret it. Long columns of figures are not easily interpreted, however recorded.

The need for an improved method of recording and displaying production information led the Keinath Instrument Co. to develop a system that displays current information in both digital and graphic form. The following information can be displayed: 1. The total number of pieces (or pounds, feet, gallons, etc.) produced by each of a number of machines, measured from the beginning of a shift or day. 2. The rate at which each machine is producing, minute-by-minute, in relation to what is normal for that machine or process. 3. The trend of the production rate—whether production is speeding up or slowing down. 4. If machine downtime has occurred, precisely when, and for how long, each machine was down. 5. The reason for the downtime. 6. An over-all summary of the total number of machine-minutes of downtime for each of several causes.

Graphic Display

The graphic recorder, *Fig.* 1, contains one master chart printed with a number of 4 inch x 6 inch chart-frames, or graphs, aligned in columns and rows. Each chart-frame is used to record the production of one machine or process, and ten chart-frames are provided on the model illustrated. The chart trace is recorded on the chart-frame by means of a master print-bar which scans periodically from top to bottom across the paper. Inside the print bar are solenoid operated hammers which print dots through a typewriter ribbon. As time passes, the dots move to the right forming a continuous line in the form of the "ramp" of production.

The key to the easy readability of the charts, and the factor which makes it unique, is the ramp chart method of recording the production data. To exemplify how a ramp chart recording shows a complete picture of production, *Fig.* 2 shows a graph of the production from each of two machines. In both cases, the height of the graph is made equal to the total number of parts normally produced in one shift, while the horizontal dimension is time, running from zero to eight hours. On the graph is recorded the

total number of pieces produced since the beginning of the shift. It can be seen that, if each machine is producing at exactly its normal rate, the record of pieces produced will follow a diagonal line starting from zero at the beginning of the shift and just reaching the upper right-hand corner of the graph at the end of the eight hours. This diagonal line, then, graphically shows the "norm." Any record above this line shows a total above normal, and conversely, a record below the line indicates below-normal production. Furthermore, if the slope of the line showing the production is steeper than the diagonal, this shows that the rate of production at that instant is greater than normal, regardless of what else may have happened during a shift.

In the example shown, it is obvious at a glance that one machine produced at above the normal rate during the entire shift, reached its eight-hour goal before the end of the shift, and (shown by the graph starting again at zero) produced additional pieces by the end of the shift. On the other hand, the second fell short of its eight-hour goal. It produced normally for the first part of the shift and then was shut down. During the last part of the shift production returned to normal, but it could not make up for the total lost during downtime.

In addition to the downtime record on the ramp chart, a separate downtime graph is provided which shows not only the time and duration, but also the cause of any downtime which has occurred. As shown on the illustration, the downtime graph has six spaces, each labelled with a category of common downtime causes. Whenever the trace on the ramp chart becomes horizontal, indicating downtime, an exactly equivalent straight line is drawn on one of the spaces of the downtime graph. This not only

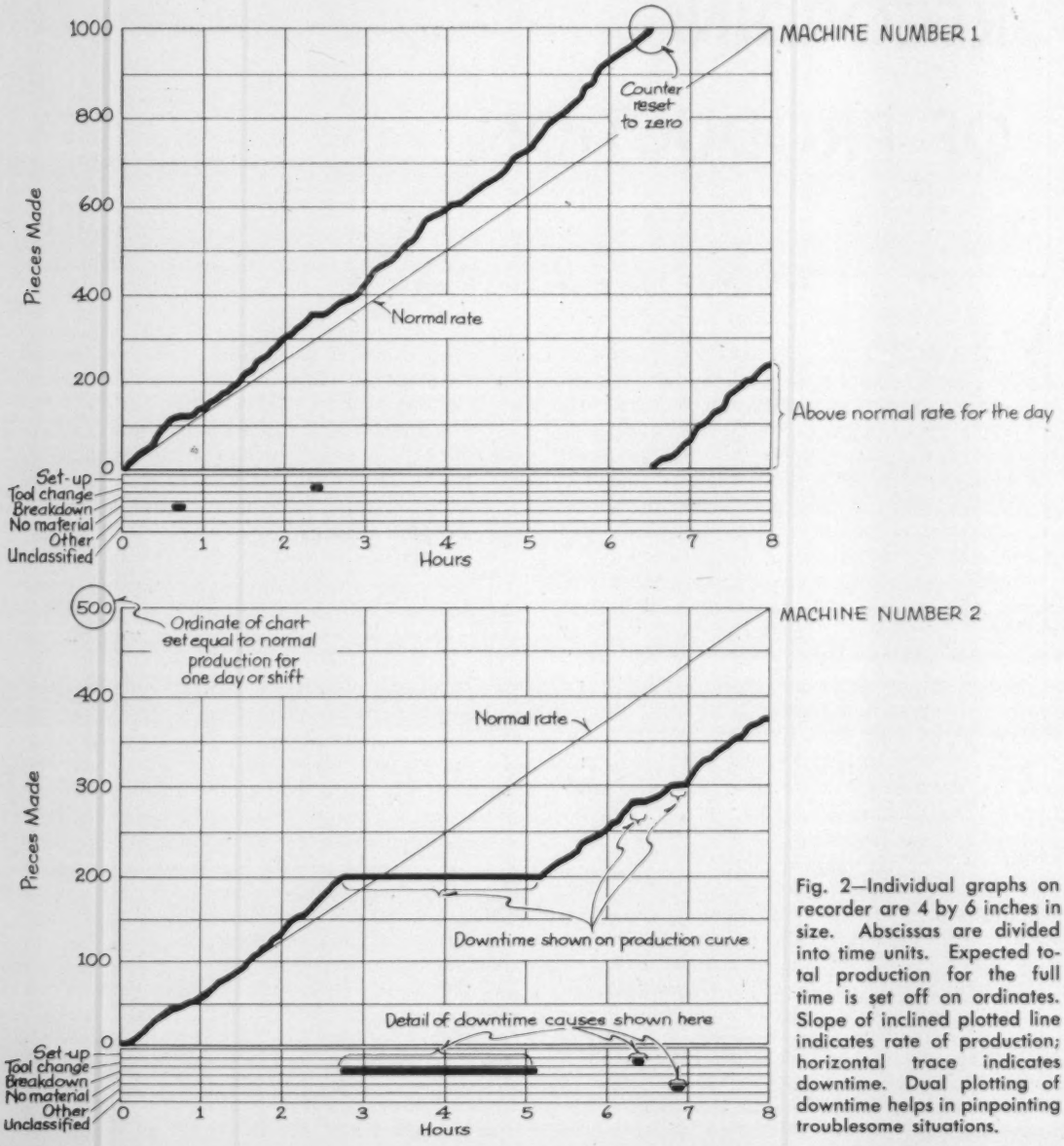


Fig. 2—Individual graphs on recorder are 4 by 6 inches in size. Abscissas are divided into time units. Expected total production for the full time is set off on ordinates. Slope of inclined plotted line indicates rate of production; horizontal trace indicates downtime. Dual plotting of downtime helps in pinpointing troublesome situations.

shows a very clear graphic record of timing, duration, and cause of major downtime period, but also calls attention to downtime periods of only a minute or two, which might be undetectable on the ramp chart.

Recorder Details

To create the production data in electrical form, so that the logger can record it, an accumulator is put on each production machine. An accumulator is a step-actuated variable resistance which makes one complete revolution, from zero to maximum, after a number of electric pulses have been fed to it. The total number of pulses required to drive one complete revolution is made equal to the normal number of pieces produced by that machine. For counting, it is only necessary to create an electric pulse for each piece (or pound, or gallon, etc.) produced. These pulses can be made by limit switches, revolution counters, photocells, pressure switches, or any other electric actuator. Accumulators can be provided having any practical range from a few up to many millions of pieces per eight-hour shift.

The principle of operation of the recorder is the familiar Wheatstone bridge. Synchronized with the sweep of the print bar over the chart, a variable resistor is swept through its range of resistance, from zero to maximum. At the instant when the resistance of the internal resistor is exactly equal to the resistance of the similar unit on the remote accumulator, the print-hammer makes a mark on the chart. Hence, each time the print-bar sweeps across the chart it simply records the total resistance which has been accumulated on each of the accumulators up to that time. This defines the ramp chart.

In order to identify the cause of any downtime which occurs, so that it can be recorded in the proper space on the downtime graph, the operator is provided with a five-position pushbutton station. Each button is labelled with a common downtime cause. On the front panel of this unit is a red alarm light. When shutdown occurs on the machine, this alarm lights up, indicating that the operator must diagnose the problem and identify the cause by means of the appropriate button. If he does not do so, the downtime is recorded as "unclassified" on the downtime graph.

Operation of the alarm light at the operator's station is repeated at the recorder. The platen, or printing surface which backs up the chart on the recorder, is translucent. The recorder alarm light is mounted behind the platen and when the light comes on, the appropriate ramp chart lights up in red.

Through the use of accessory digital counters, a summary is made of the total downtime loss in the entire department. The counters are built into the side of the recorder, *Fig.* 1. The top six counters give the total machine-minutes lost for each of the five classified and one unclassified causes. The remaining counters are provided as optional features to accumulate in digital form the piece count from each machine, starting from the beginning of each job-order.

Other Operations

The Wheatstone bridge circuit of the recorder makes possible certain other functions over and above the recording of the total number of pulses accumulated. Simple arithmetic operations can be performed by positioning of resistances on the various arms on Wheatstone bridge. Hence, without additional computing circuits of any kind, the recorder can perform addition, subtraction, or multiplication. For example, the output of a number of machines can be recorded separately on several chart frames, then the total of the machines can be added together and recorded on another chart frame. Or, if it is desired to record good production and if separate counts of the total rejects are possible, the recorder can subtract the total rejects from the total produced to record only the total accepted.

A specific example of arithmetic computation which deserves separate mention is the calculation of tonnage of sheet or strip materials. In basic metal production, papermaking, paper converting, plastic extrusion, and elsewhere it is often desirable to know at all times the production rate in pounds per minute or tons per hour. However, the only production factor which is subject to direct measurement is the lineal footage per minute or hour. The recorder can be used to accumulate pulses representing lineal feet of strip, and multiply this factor by width and thickness, or weight per unit of area (either total weight or the weight of coating applied) to express on the ramp chart the production rate in tons rather than feet or yards.

In many job-shops, the normal production rate of each machine is not a constant. Instead it changes with each order, depending on what type of work has been assigned to each machine. In cases such as this, the graph is made to read in "Percent of Normal," from 0 to 100 per cent. The absolute number of pieces represented by 100 per cent is set for each order by the production control department, simply by setting a dial inside a locked cabinet. In this way a supervisor can see a meaningful record of production from a machine whether its normal rate is 10 or 10,000 pieces per shift.

A slightly different kind of production recording situation from that discussed so far, is one in which it is necessary to relate certain process variables to the production rate. Certain models of the recorder can record electrical quantities and variables which can be transduced into electrical quantities. Sizes up to 100 chart frames are possible. On these recorders the temperatures, pressures, and flows are recorded alongside the production ramp chart to show cause and effect relationships. Practically any information relating to production rates can be recorded in direct relationship. In-process inventories, material flows, ampere loads, spindle speeds, hopper levels, and other significant variables can be handled to give a truly complete picture of the conditions throughout a production operation.

LIMIT SWITCHES PROGRAM DUAL-PRODUCT LINE

Four automatic machines provided with interlocked handling devices become an automatic line processing two different part styles in variable ratios. Thirty-three limit switches are the basic input devices used in control of the handling system and feeding of the proper part style to each machine.

AUTOMATIC production machines are now in use for many operations. Simply load the parts and watch the machine do the rest. In many cases an operator may be able to handle several machines by walking from one to another. However, he may have to cover a lot of mileage and may have real problems if he is expected to selectively feed a mixture of part types to his machines.

At Chrysler's Trenton Engine Plant there are four automatic machines performing similar milling operations on two styles of connecting rods—one long style, one short style. A single operator feeds all four machines without being continually on the move and without continually trying to remember which machines are set up for which styles. Approximately 1280 parts are milled per hour.

The operator takes connecting rods from an overhead conveyor, *Fig.* 1, and places them in alternate long and short pockets on a flat top chain conveyor that runs past his position, *Fig.* 2. The chain conveyor advances three pocket increments on every index. Long and short parts are thus alternately stopped in line with transfer mechanisms at the four machines. Machine positions along the conveyor and number of pockets on the conveyor are such that when a short pocket is in position for Machine A, long pockets are in position for Machines B, C, and D, and vice versa.

A timing wheel linked to the chain conveyor actuates limit switches which indicate whether long or short pockets are positioned at the transfer points for the respective machines. The control system determines whether or not the part in position at each machine is the style of part for which that machine is set up. Machine A runs only short parts and Machine D runs only long parts, so their requirements bear a fixed relationship to the timing wheel indication. Machines B and C can independently run either long or short parts with tool changes. To indicate which parts are required for these machines, a limit switch on each of them is operated by the setting of the tooling on the machine.

Since the four machines in the line cycle independently, they only receive parts on demand. When the index mechanism on a machine is in position to receive a new part, it trips a limit switch. If at the same time another limit switch indicates that no part is in that position on the index mechanism, an air-operated transfer mechanism is allowed to slide a part from a pre-load pocket onto the index mechanism.

The return of this transfer mechanism operates another limit switch. If still another limit switch simultaneously indicates that there is no part in the pre-load pocket, another air-operated transfer mechanism may be actuated to slide a part from the flat top chain conveyor into the pre-load pocket.

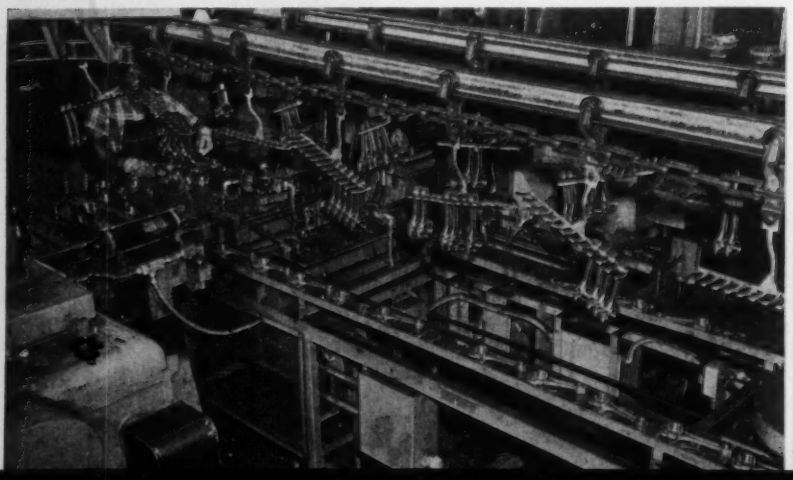


Fig. 1—Four machines to mill long and short connecting rods are supplied by one operator. He takes connecting rods from the overhead monorail conveyor and places them in alternate long and short pockets on the flat top chain conveyor. Parts are automatically moved into the appropriate machine, milled, and discharged to belt conveyors. Cooney Industries Inc. supplied the loading system.

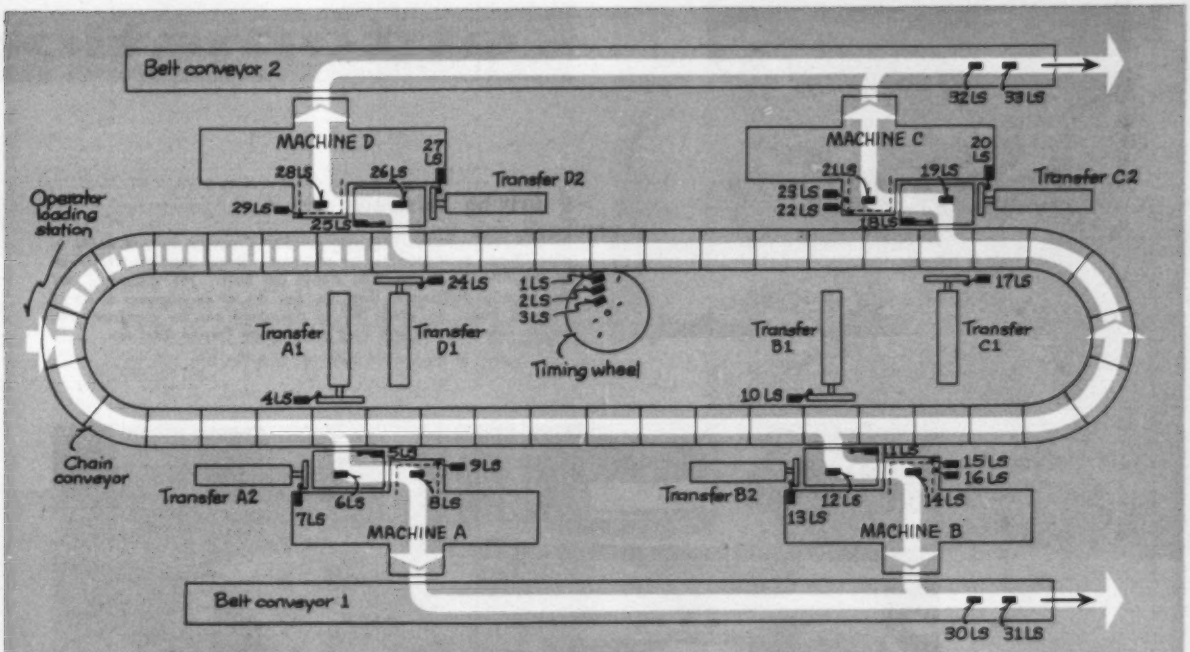


Fig. 2—Diagram indicates plan layout of equipment and functions of the limit switches used to control cycle actions so that each machine is supplied with parts of proper length. Machine A mills short parts and Machine D mills long parts, but Machines B and C can be independently set up to mill either long or short parts.

Limit switch	Operated when
1LS	Chain conveyor is stopped with short pocket at Machine A; long pockets at Machines B, C, & D
2LS	Chain conveyor is stopped with long pocket at Machine A; short pockets at Machines B, C, & D
3LS	Conveyor chain moves 2 inches from stop position
4LS	Transfer A1 is back
5LS	Transfer A1 is forward
6LS	Part is present in A1 unload position
7LS	Transfer A2 is back
8LS	Part is present in A2 unload position
9LS	Machine A index is back
10LS	Transfer B1 is back
11LS	Transfer B1 is forward
12LS	Part is present in B1 unload position
13LS	Transfer B2 is back
14LS	Part is present in B2 unload position
15LS	Machine B index is back
16LS	Machine B is set up for long parts
17LS	Transfer C1 is back
18LS	Transfer C1 is forward
19LS	Part is present in C1 unload position
20LS	Transfer C2 is back
21LS	Part is present in C2 unload position
22LS	Machine C index is back
23LS	Machine C is set up for long parts
24LS	Transfer D1 is back
25LS	Transfer D1 is forward
26LS	Part is present in D1 unload position
27LS	Transfer D2 is back
28LS	Part is present in D2 unload position
29LS	Machine D index is back
30LS	Parts are backed up on Belt Conveyor 1
31LS	Parts are backed up on Belt Conveyor 1
32LS	Parts are backed up on Belt Conveyor 2
33LS	Parts are backed up on Belt Conveyor 2

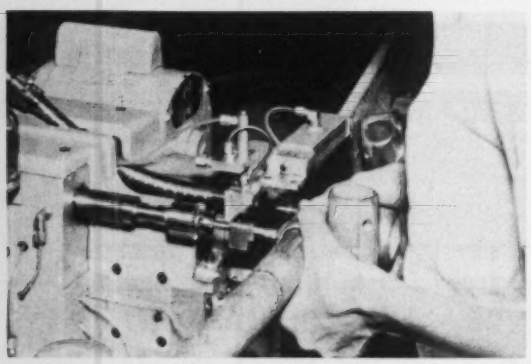
The action of the conveyor unloading transfer is also interlocked with the chain conveyor drive and the timing wheel. The transfer mechanism that unloads the conveyor is only actuated when the conveyor is stopped with the proper length pocket in position at the machine.

All four machines are equipped with similar basic limit switch controls on their associated transfer mechanisms. The chain conveyor drive is of course interlocked with the transfer mechanisms that unload the conveyor. All four of those mechanisms must operate limit switches to indicate that they are in their retracted positions before the conveyor is advanced.

Two parallel steel belt conveyors receive the milled parts which are ejected from the machines. Two limit switches are provided on each of these conveyors to indicate when the parts on these conveyors back up to given positions. If that occurs, the two machines feeding that belt conveyor are not fed any more parts from the chain conveyor until the backup is cleared.

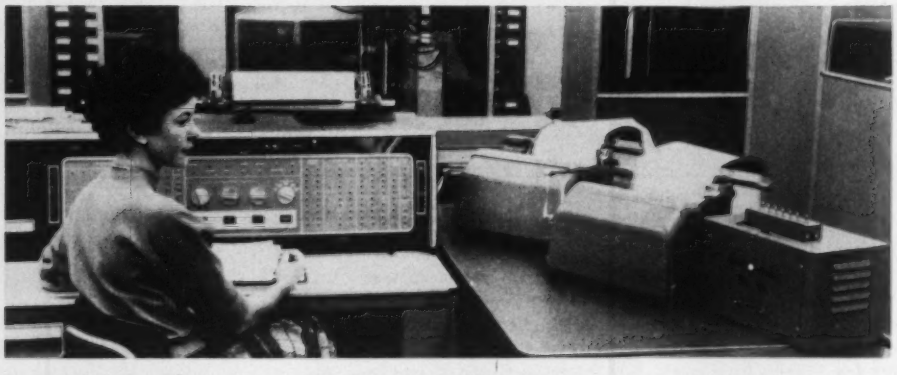
By use of this loading system with limit switches and related relay control circuits, the four automatic milling machines are efficiently operated by one man. Loading of proper part styles into respective machines is controlled, and the four independent machines operate as a co-ordinated line.

automation



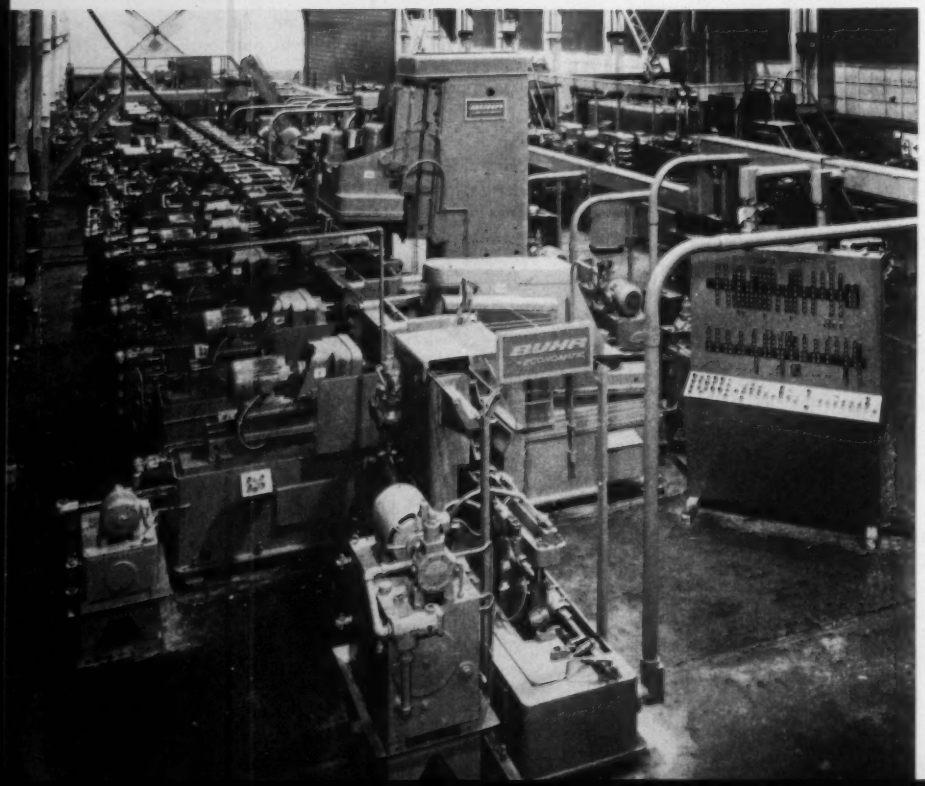
Driving Setscrews

HOPPER-FED setscrews are automatically driven to uniform depth in pipe fittings positioned by the operator. Screw insertions are made at the rate of 750 to 1200 screws per hour. The success of this operation at Hollaender Mfg. Co. has led to development of rotary indexing tables on which drilling operations can be combined with similar screw driving units built by Standard Pressed Steel Co.



Linking Shop Areas To Computer Memory

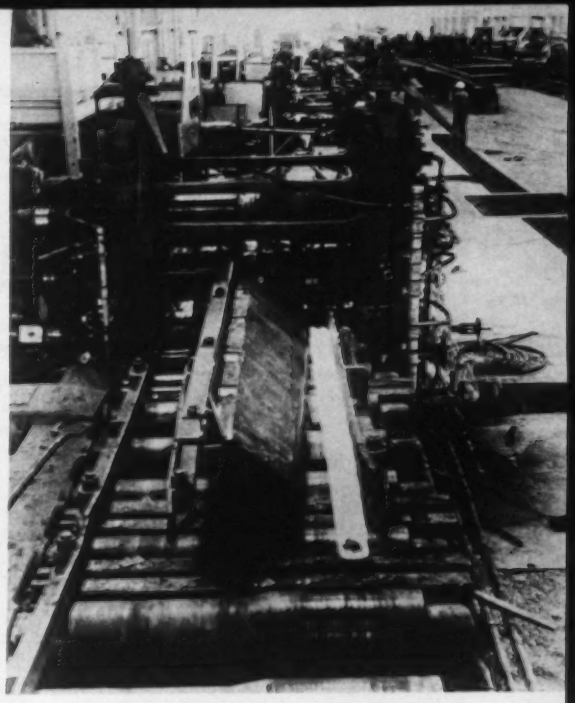
STANDARD teletypewriters at key work load centers in California Division Plant of Lockheed Aircraft Corp. make inquiries to and receive answers from this central information center. The operator is seated at the console of the IBM RAMAC 305 which is queried through communications equipment supplied by Telautograph Corp. The system supplies job status information on the 60,000 open orders normally in the plant.



Machining Transmission Cases

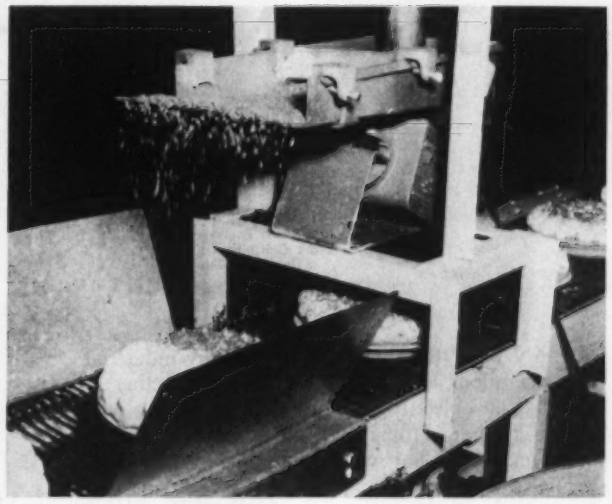
IN-LINE transfer machine performs 120 drilling, milling, reaming, spotfacing, chamfering, and tapping operations; two automatic assembly operations; and a staking operation. Built for the Detroit Transmission Div., General Motors Corp., by Buhr Machine Tool Co., the machine has 67 stations and a capacity of 180 pieces an hour at 100 per cent efficiency.

in action



Rolling Bar Products

ROLLING mill at Ceco Steel Products Corp. rolls bar products directly from billet-size ingots wiith no catchers required. The 15-stand mill is equipped with automatic gaging and weighing devices, conveying tables, bar turning and repeating equipment, hot and cold metal shears, and a 200-ft mechanical cooling bed. Birdsboro Corp. built the bar mill which is operated by a crew of nine.

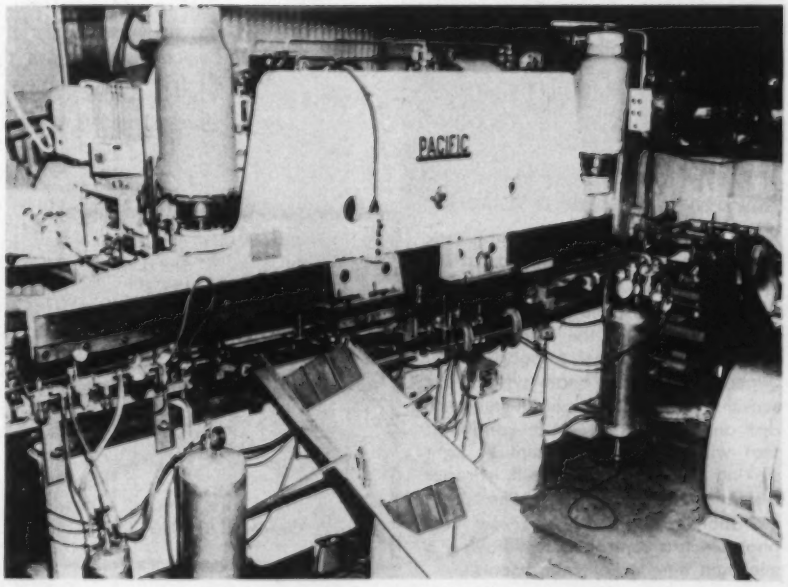


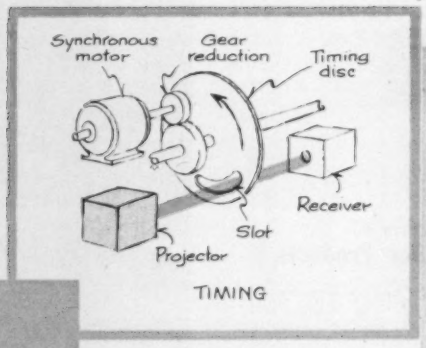
Coating Pies

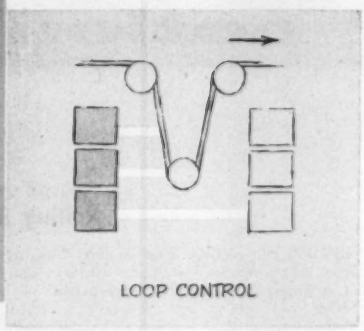
PIES are automatically coated with controlled amounts of shredded coconut, chocolate decorettes, or butterscotch bits on this line at Blue Bird Baking Co. Besides improved appearance, the uniform coatings obtained are credited with substantially reducing wrapping problems. Eriez Mfg. Co. supplied the vibratory feeder which spreads coatings on more than 10,000 pies daily.

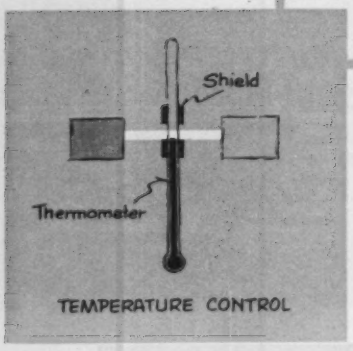
Making Shingles

OPERATING at 40 strokes per minute, hydraulic press brake in automatic line produces shingles of 0.020-gage aluminum at Precision Industries. Coiled aluminum strip is fed from a cradle through an air slide feed, and progressive dies emboss, pierce, and form the shingles. The press is a 150-ton unit manufactured by Pacific Industrial Mfg. Co.









SENSING WITH

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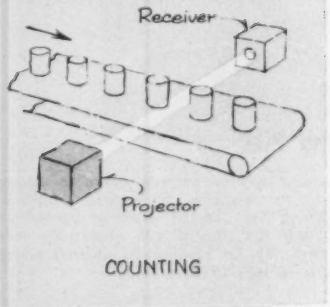
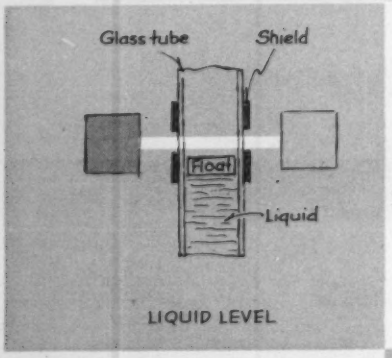
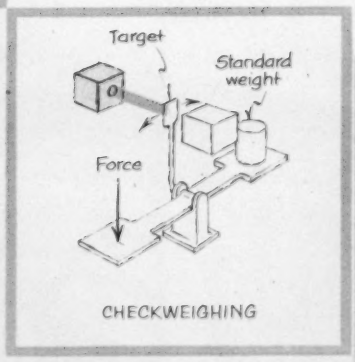


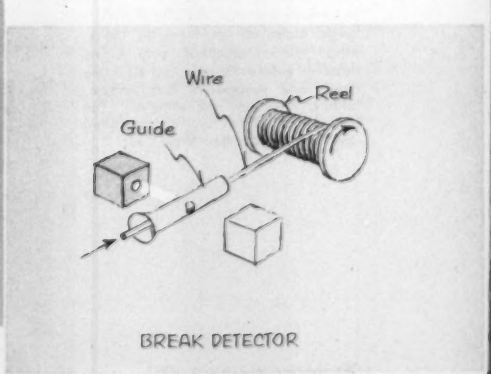


AN IMPORTANT PHASE of many industrial operations is a determination as to whether or not an object is at a particular place at a particular moment of time. This determination can be made manually, but when many points must be monitored within a short period of time, remote mechanical, electrical, or electronic sensing devices must be used. Of the many types of sensing devices available to the manufacturing engineer, the photoelectric cell is one of the most versatile and widely used.

Many different photoelectric controls are available having a wide variety of operating characteristics. Basically, there are three different types of photoelectric units, namely, continuous beam, modulated

Fig. 1—Continuous beam photoelectric controls can be used as noncontacting limit switches in many types of industrial applications. The examples shown are only a few of the many possible uses in the various categories. In general, continuous beam systems are sensitive to ambient light fluctuations, dirt on lenses, and other conditions that will affect the amount of light striking the photoelectric cell. Proper system design can overcome these limitations and provide a low cost photoelectric control system having a minimum number of components.





Photoelectric devices have become widely accepted as sensing means in control systems since they do not require physical contact with the part or product being sensed. An understanding of the basic types of photoelectric controls available to industry is essential to proper usage.

PHOTOELECTRICS

beam, and pulse-sensitive. By far the most common system is the continuous beam photoelectric control.

▸ Continuous Beam Systems

The continuous beam or general purpose control has been used in many different applications with much success, *Fig.* 1. Its wide use is largely due to its versatility and comparatively low initial cost. A general purpose light relay is fast operating, may have very compact projectors and receivers, and will provide ranges from a few inches to in excess of 1000 feet. Its low cost is attributed largely to the simplicity of design and minimum number of components required.

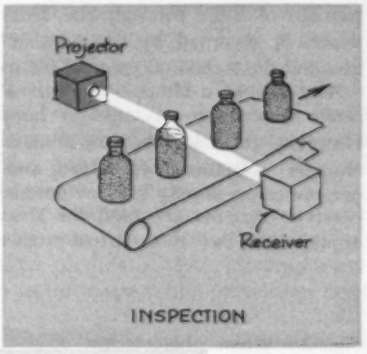
Continuous beam systems have limitations which should be considered when applying or purchasing equipment. These systems are sensitive to ambient light fluctuations, dirt on lenses, and, in general, any condition which will affect the amount of light striking the photocell. Therefore, these systems should be used rather discriminately where ambient light fluctuations or contaminating atmospheres are present and may require shielding against these objectionable influences. The lack of consideration of these limitations has resulted in disappointment to many a user and has to some extent, without justification, undermined confidence in photoelectric control.

Reliable operation of a general purpose system must necessarily be achieved through overdesign wherein the projector produces a light several times more brilliant than any anticipated ambient light. This requirement often results in the necessity of high candlepower projectors, particularly when long ranges are involved. Successful outdoor operation of general purpose systems can be achieved only through careful planning since extreme ambient light fluctuations and weather conditions such as fog, snow, and rain can have adverse effects on the amount of light striking the photocell.

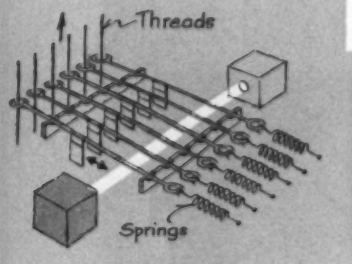
Normally, the application of general purpose light relays should be confined to inside use where ambient light is relatively constant and where uncontrollable dust, dirt, steam, or vapors are not present to change the operating characteristics of the system.

▸ Modulated Light Systems

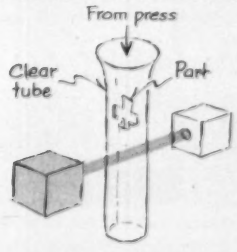
For the most part, modulated light systems are insensitive to ambient light and have become increasingly popular because of this desirable operating characteristic. These systems are not susceptible to failure due to dirty lenses, heavy fogs, or vapors



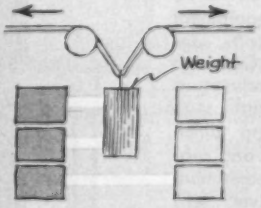
INSPECTION



STOP MOTION



PRESS INTERLOCK



TENSION CONTROL

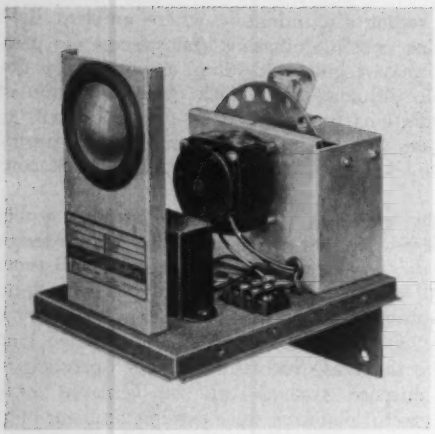


Fig. 2—Modulated or pulsed light is produced mechanically in a projector by rotating a disc, having holes in its periphery, between the light source and the lens. Light is alternately blocked and allowed passage through the lens at a rate of 540 cycles per second. When the modulated light beam is not interrupted, a receiver converts the light pulses to electrical pulses which are amplified and fed into the grid circuit of a thyratron. The thyratron operates to hold in a control relay. When the light beam is interrupted, the control relay drops out and provides a signal to stop a machine. The system is fail safe since power or component failure will also cause the control relay to drop out.

since operation is achieved only through complete obstruction of the light beam from the projector to the receiver. This "selective operation" of a modulated light system is the result of using pulsed or modulated light at the projector. The photocell and associated control amplifier are tuned to the pulsed light frequency. This modulation prevents detection of ambient light which is usually unmodulated or varies at a frequency different than that of the pulse rate produced at the projector.

Two methods of producing modulated light are normally employed, both having advantages which are worthy of consideration. The most common method is through the use of a mechanical "chopper," *Fig.* 2, which usually consists of a motor-driven disc having holes in its periphery. This disc is located in the projector between the light source and the lens and alternately blocks and allows the passage of light through the lens at a fixed rate which is governed by the number of holes in the disc and the rotational speed of the motor.

The use of a chopper permits a long projection range since high candlepower lamps may be used. However, projectors become somewhat bulky when chopper mechanisms are added, and miniature chopper projectors simply are not practical. Hence, chopper-type systems are used for short or long range applications, but where size of projector is not limited.

The second method of producing modulated light consists of electrically pulsing a light source on and off. This method permits the use of small components since only the light bulb need be located in the projector. Operating ranges are substantially reduced, however, since the modulation produced is not as high in frequency or as sharply defined as that produced by a chopper disc. For example, thermal inertia does not permit a high-intensity filament-type lamp to faithfully reproduce or follow high-frequency pulsing of an electrical signal. An advantage of an electrically modulated light relay is its low cost. In many cases, equipment can be purchased at less cost than equivalent general purpose beam controls. Savings in materials and construction accrue because less powerful projectors and less refined lenses are required, and shielding is eliminated. These factors make possible extremely reliable equipment at low costs.

Through the use of modulated light, a long range (operating distance from projector to receiver) can be achieved with moderate and low power sources. Since these systems are sensitive only to their own modulated light, it is not necessary to produce a light at the projector which will reach the receiver still several times more brilliant than ambient. In fact, a modulated light system will operate with signals far below 1 per cent of ambient light intensity.

Modulated light relay systems are well suited for either indoor or outdoor operation. Ranges have been achieved, without difficulty, up to several thousand feet with entirely reliable operation. When used outdoors, fog, rain, or snow have little effect on op-

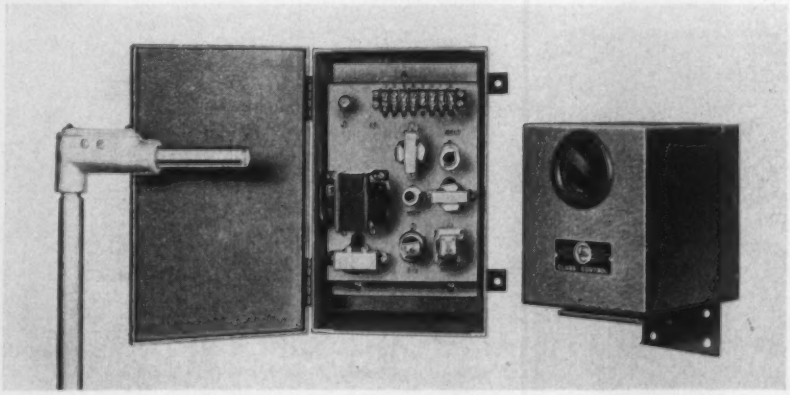


Fig. 3 — When photoelectric systems are employed as an operator protection device on machinery, the equipment should be specifically designed for this use. One such system, shown, produces a narrow modulated light scan beam for protecting pinch points on roll forms and rubber calenders. The equipment consists of a receiver, left, equipped with a sighting tube; a control unit, center; and a modulated light projector, right.

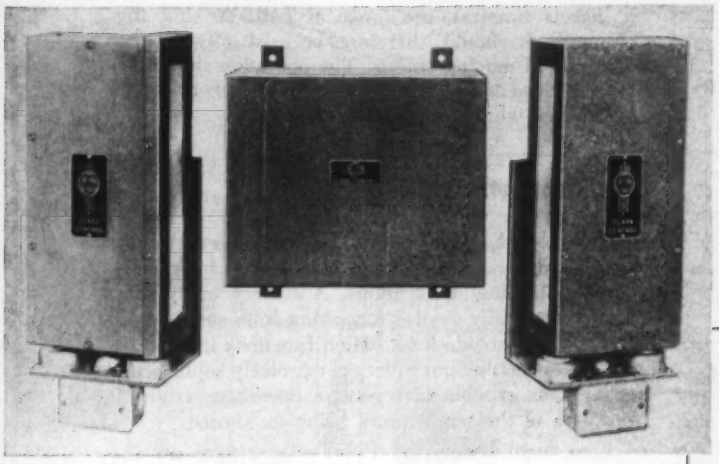
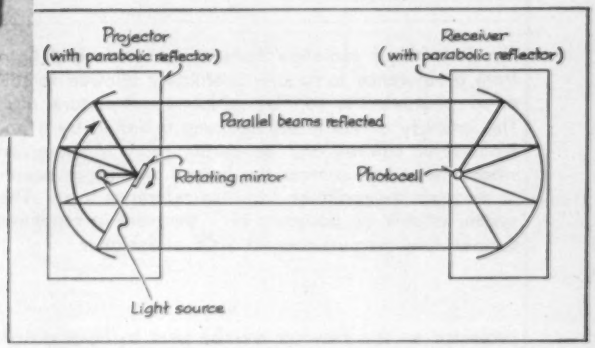


Fig. 4—When protecting large areas of machinery, a "curtain of light" photoelectric protective device can be used. In this case, a rotating mirror sweeps a light beam across a parabolic reflector, producing parallel beams of light that are directed to the receiver. A second parabolic reflector in the receiver intercepts the beams and focuses them onto a photoelectric cell. If 2 inches or more of a 17 inch wide curtain is obstructed, the equipment will actuate a relay to stop the machinery.



eration since it is necessary to completely block all light from projector to receiver. These conditions normally only partially obstruct the beam. Operation in areas where vapors are present, or where lenses are likely to become dirty, likewise is feasible.

When photoelectric systems are to be used as protective devices, precautions must be taken to ensure safe operation at all times. Extreme caution should be used when employing equipment not specifically designed as protective devices for this type of application. Modulated light systems are ideal for the protection of personnel operating machinery since they can be designed to have high sensitivity to partial obstruction of the light beam, and they are unaffected by ambient light conditions.

A photoelectric protective device which uses modulated light is shown in *Fig.* 3. In this case, a "pencil of light" is used to monitor very narrow access areas such as pinch points on power brakes, shears, rollforms, and rubber calenders. The system consists of a separate modulated light projector, a receiver, and a control unit. Obstruction of a narrow 1/16-inch scan line by a finger or a hand automatically stops machinery to prevent operator injury. The scan line is produced by the receiver which monitors modulated light from the projector through two aperture discs at both ends of a sighting tube on the receiver. Maximum range of the unit is about 20 feet.

Another type of photoelectric protective equipment is shown in *Fig.* 4 and is called a "curtain of light." This system consists of a wide beam modulated light projector, a wide beam receiver, and a control unit. Curtains can be from 7 to 17 inches wide, and obstruction of 2 inches or more of the light curtain will produce a signal. Hence, an operator reaching into press dies will obstruct part of the wide beam and provide a signal to stop the downstroke of a press. Modulated light is produced in a different manner than the methods previously indicated in order to cover a wide area.

To produce the modulated light beam in the projector, a light source is focused on a rotating mirror which is located at the focal point of a parabolic reflector. As the mirror rotates, the light beam sweeps across the reflector, producing sweeping parallel beams of light that are directed to the receiver. In the receiver, the light beams are focused by a second parabolic reflector onto a photoelectric cell located at the focal point of the reflector.

In normal operation, a series of electrical pulses are generated in the receiver, two pulses with each complete rotation of the mirror. These pulses are fed into the control unit where an integrating circuit monitors the incoming signal. Should the pulse width be reduced, as would be the case if partial obstruction of the light curtain occurred, a signal is produced which drops out the control relay and shuts down the mechanical equipment.

In most industrial applications of photoelectric equipment, reliable operation with a minimum of adjustments is desired. Modulated light systems are usually much better in this respect than continuous beam systems.

▶ Pulse-Sensitive Systems

The main functional use of pulse-sensitive equipment is the detection of fast-moving objects. Typical applications include register detectors for printing, protectors for dies, and counters for small parts. A pulse-sensitive device is composed essentially of a time-rate-of-change detector, an amplifier, and usually a quick-make, slow-break relay to provide a useful output signal of sufficient duration to operate other devices.

In operation, a continuous beam light source is projected directly to a receiver or reflected from the

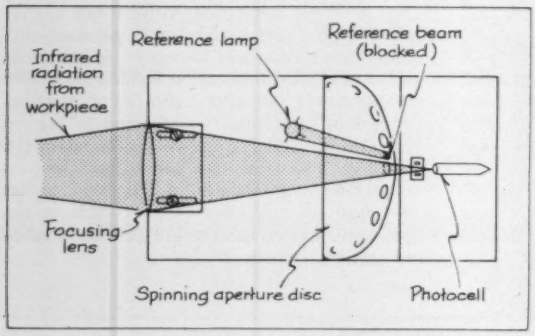


Fig. 5—Infrared radiation from a workpiece and light from a reference lamp are alternately allowed to fall on a photoelectric cell by a spinning aperture disc. The intensity of the reference lamp is varied by a potentiometer control, and an output relay is energized when the radiation from the heated workpiece equals or exceeds the radiation from the reference lamp. This system attains an accuracy of 1 per cent in repetitive temperature measurement at 500F and higher.

projector to the receiver by the part to be scanned. The output signal from the photoelectric cell is filtered, usually by a simple resistance-capacitance network, and the dc component of the signal is blocked from the input to the amplifier. However, a signal with a high time-rate-of-change, or a pulse, is amplified since it is not blocked and will operate a relay, even though its amplitude may be only a small per cent of the dc signal component.

Partial obstruction of the light beam is usually all that is required for successful operation, and relatively small parts can be detected with a wide beam, provided they are moving at a relatively high velocity. When using reflected light, small marks are easily detected on an otherwise constant colored background as long as they are in motion. Pulse-sensitive equipment depends upon motion since it detects time-rate-of-change of light striking the photocell. It should, therefore, be used only for the detection of moving objects. The operation should be well shielded from other light sources, such as welding flashes, which could cause false signals.

▶ Heat Detecting Devices

The high sensitivity of photoelectric cells to infrared radiation makes them ideally suited for temperature-sensing applications. A variety of systems are commercially available, varying from simple controls which provide limit switch functions from heated bodies such as hot billets to extremely sophisticated systems capable of repetitive operation within 1 per cent of the temperature being monitored.

One such device, the PyroTemp, attains an accuracy of 1 per cent in repetitive temperature measurement at 500 F and higher. A unique comparison system in which radiation produced by an adjustable reference source is compared against radiation of the object being monitored is the heart of the system, *Fig.* 5. Operation is comparable to that of an optical pyrometer with the exception that a photoelectric cell is substituted for the human eye.

For example, in *Fig.* 5, infrared radiation from a heated workpiece is focused on the moving apertures of a spinning disc so that radiation falls on a photoelectric cell whenever an aperture passes between the lens and the photocell. A reference lamp is also focused on the spinning disc in such a way that "reference pulses" are generated as the photocell first sees the reference lamp and then sees the heated workpiece. The intensity of the reference lamp is varied by a potentiometer control, and an output relay is energized when the radiation from the heated workpiece equals or exceeds the radiation from the reference lamp. Since the photoelectric cell and amplifier sense only the difference or equality of the two signals, any drift in photoelectric cell sensitivity or amplifier gain has no effect on accuracy.

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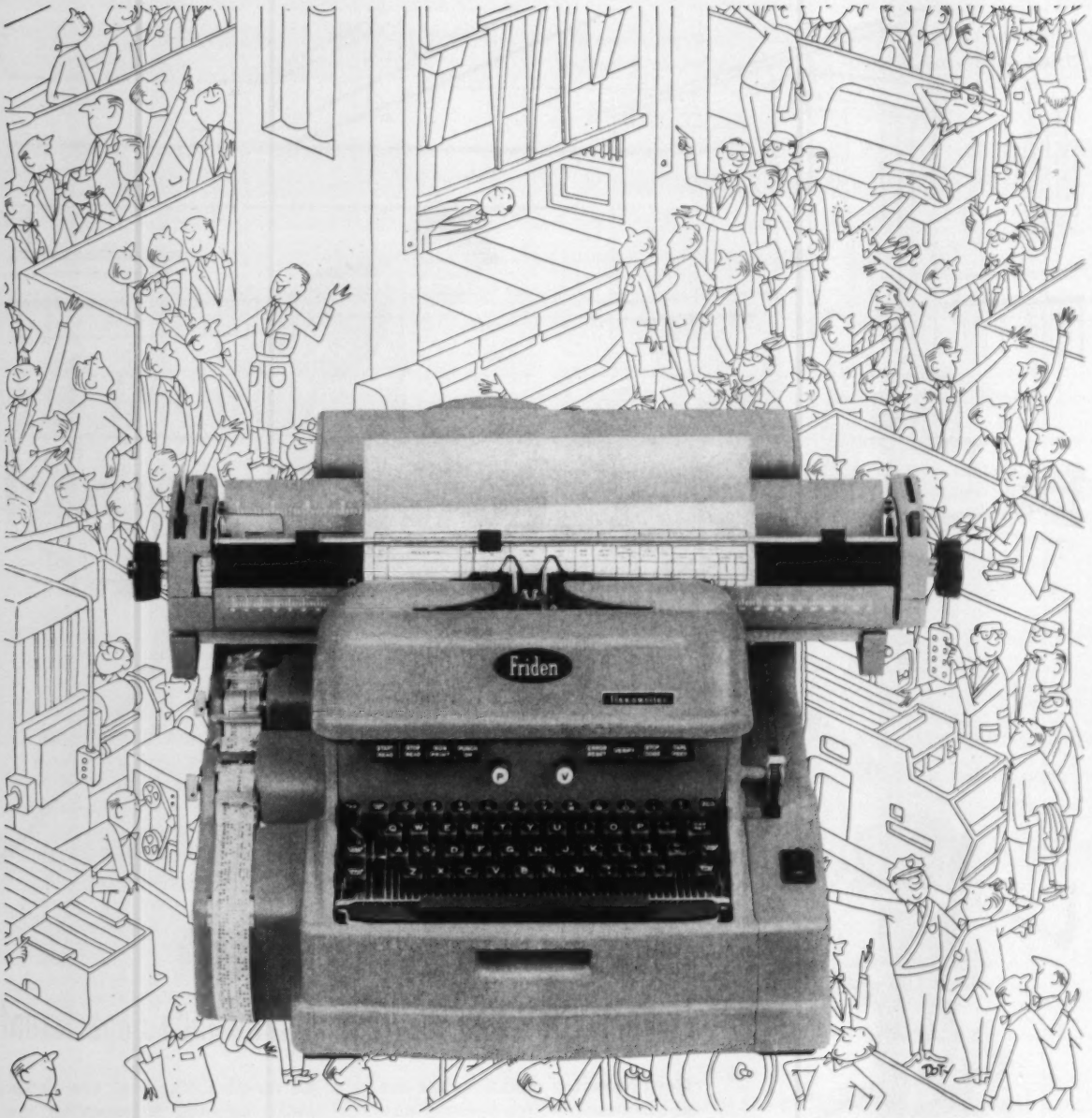

The Friden Flexowriter®: Machine Tool's Machine Tool

At the recent Machine Tool Exposition, approximately 80% of the numerically controlled tools on display featured 8-channel punched paper tape input.

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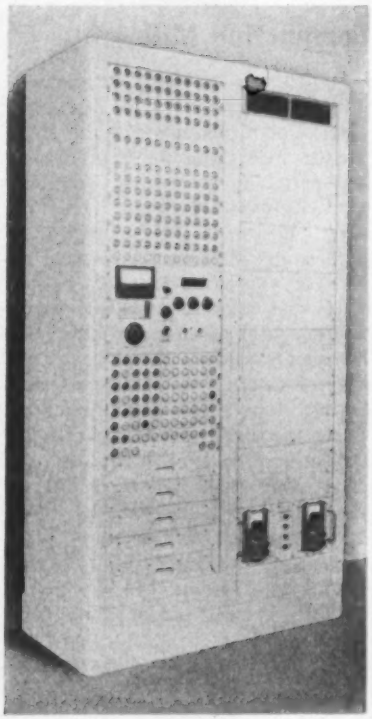
Electronic Alarm Indicating Monitor

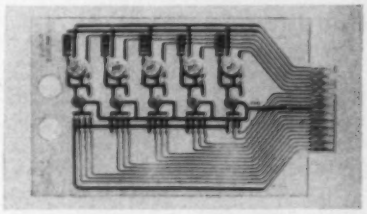


Alarm indicating monitor is designed to monitor any input that can be represented by a dc voltage as low as 10 millivolts full scale. The readout and alarm panel for one 200-point unit will fit into a panel area only 19 by 47½ inches.

ALARM indicating monitor, developed by **Hagan Chemicals & Controls Inc.**, Hagan Center, Pittsburgh 30, Pa., is designed to oversee as many as 200 high or low temperatures, pressures, flows, levels, or contact closures at the rate of five points per second. Capable of monitoring any input that can be represented by a dc voltage as low as 10 mv full scale, this device is applicable to iron and steel plants, petroleum refineries, petrochemical complexes, electric generation stations, cold storage plants, and other industrial processes.

Display lights on the control panel indicate to operators that out-of-limits conditions are occurring and indicate the point's name and number. When an alarm occurs, a warning horn also sounds. The horn may be silenced by an acknowledgment button, but the alarm light will remain lit until the out-of-limits condition is rectified. Limits are individually set by inserting pins in a pinboard. Alarm accuracy is ±0.1 per cent full scale. Detection of an out-of-limits signal is obtained by comparing the voltage from the alarm set point pinboard to the voltage from the monitor's dc amplifier. Only

Close-up shows view of AIM control panel. At upper left is readout meter with four scales. Three control knobs under point identification window permit manual selection of point for readout. Test switch provides complete alarm circuit and alarm light check as well as circuit continuity check on input transducers to check for open thermocouples or transducers and input selection relays.



Printed circuit logic card is one of 12 types used in this alarm indicating system. These cards perform **AND, OR, NOR, NOT,** and **DELAY** decisions for implementing input sequencing, time delay for amplifier balancing, select alarm values, address proper alarm lights, determining alarm condition, and address input matrix for readout.

12 different basic printed circuit logic boards are used in a typical system. Combinations of these boards provide for input sequencing, time delay for amplifier balancing, selecting alarm values, addressing alarm lights, determining alarm conditions, and addressing input matrix for readout.

Input devices are glass envelope, hermetically sealed reed relays, rated at 100-million operations. Manual readout of any point, accurate to ±1 per cent full scale of the increment selected, is available continuously. Once each two-second period the system selects the point addressed for manual readout and, in 200 milliseconds, applies its signal to the readout meter. The meter holds this reading until two seconds later when the next reading is taken. Precise readings over wide thermocouple ranges are accomplished by the use of range suppression and linearization. To provide visual check of the present location of the scanning address, and to indicate that continuous scanning is in operation, point identification is continuously displayed in digital form in lighted numbers on the control panel. Self-checking devices are incorporated into the monitor.

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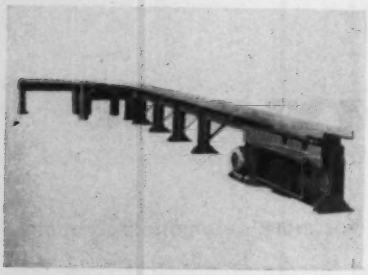

Handling System

System for storing as well as conveying parts is adaptable to nearly any application where solid materials can be conveyed on a horizontal plane. In automotive industry Live-Flow System is currently conveying and storing automotive input shafts, hot trimmed connecting rods, hydraulic transmission assemblies, etc. Multiple carriers, if used in the system, enable the storage of thousands of small parts. Parts can be fed into operations or assembly locations at a speed to meet production requirements. Conversion units for annealing or hardening furnaces come complete, ready to set in furnace, replacing other types of conveying equipment such as pusher trays or chains of miscellaneous construction. This type of equipment allows carriers to be continually in the heat, effecting a saving in fuel costs. **Mathews Conveyer Co.**, Ellwood City, Pa.

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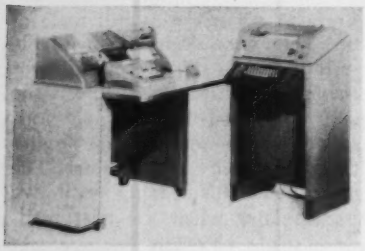

Telepunch Intercouplers

Series of telepunch intercouplers provide direct machine-to-machine connection between IBM card punches and standard Model 28 Teletype sending and receiving sets. These devices provide prompt, accurate input data to processing equipment, and the rapid communication and conversion of punched card output data in a printed copy form. Another of their functions is translation of source information or input data from manual keystroking to punched cards and punched tape, or from one machine language to another. The T585 Telepunch Transmitter permits transmitting from IBM cards or 8-channel punched tape directly to standard equipment. Speed of transmission is governed by a timing module. The T8045 Telepunch Card Receiver (shown) provides on-line IBM card punching of incoming Teletype messages. Punching of all IBM alphanumeric codes and 11 special characters is possible. Nonstandard IBM characters, such as multiple line printing codes, may be punched by plugboard wiring through distributors. **Systematics, Div., General Instrument Corp.**, Hawthorne, Calif.

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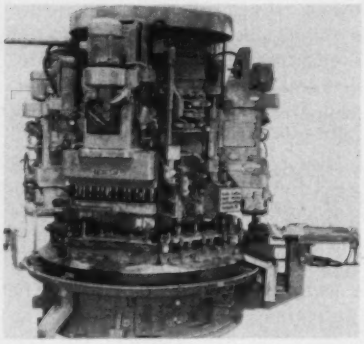

Vertical Drilling Machine

Fifty-seven spindle machine is capable of both drilling and milling 800 steel forgings an hour at 100 per cent efficiency. Production is 400 automotive-type connecting rods and 400 rod caps per hour. Having a diameter of only 11 feet, the unit can be easily fitted into existing production lines. Drill heads travel on round bars. The bars are made of SAE 4620 steel and are ground to a 5 to 8 micro-inch finish. Each drill head is self-contained. Machine fixtures are hydraulically operated. Heads 2 and 4 are powered by a 15-hp motor; the other machining heads are powered by 5-hp motors. Drilling on the machine is done at the rate of 3 inches a minute and reaming at 5 inches a minute. Loading of each fixture with 3 rods and 3 caps is manual, but unloading is automatic. **Foote-Burt Co.**, Cleveland 8, Ohio.

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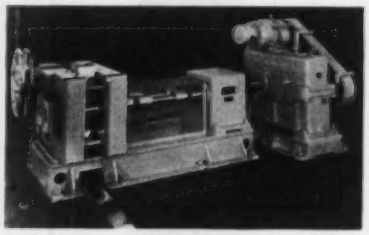

Compacting Mill

Horizontal powder compacting mill is ideally suited for the production of nickel strip for the electronics field and for the manufacture of nuclear fuels, stainless steel filters, and copper radiator stock. Feature of the machine is its edge control device comprising a pair of specially designed elastic disks that rotate at the roll edges to form strip to an exact width dimension, with a perfectly square edge, entirely without notches and cracks. One set of pressure rollers forces the disks against the rolls at the bite, while another set lifts the disks away from the roll body beyond the bite. The strip can then leave the roll gap without side friction, protecting the sensitive strip edges. **Loma Machine Mfg. Co. Inc.**, 114 E. 32nd St., New York 16, N. Y.

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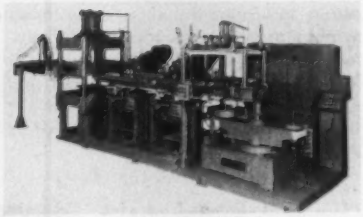
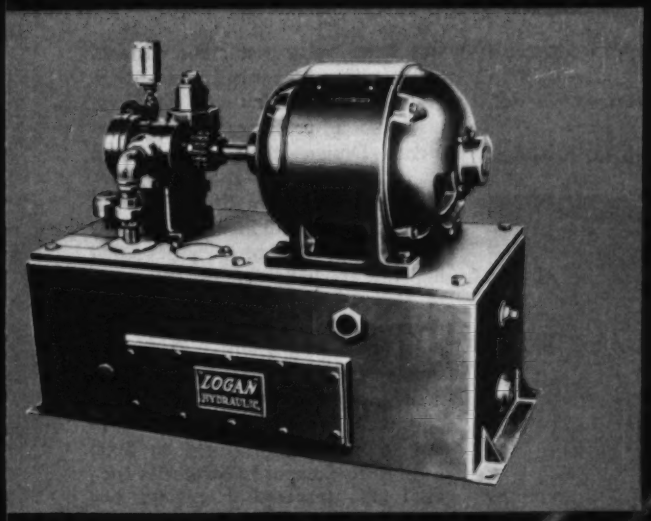


Disk Notching Machine

Stator, rotor notching and parting system holds and stores disks, transfers disks to stator notching press, transfers disks to rotor notching press, transfers disks to part press, stacks finished parts, and performs all operations simultaneously. It increases production while maintaining constant quality; saves time,



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manpower, and storage space; makes it unnecessary to change spindles; and eliminates skid stacking and out-of-parallel stacks caused by tapering of laminations (stacking spindles are indexed 90 degrees). Lamination specifications are O.D., 18 to 36 in.; weight, No. 24 gage material. Features include dual arbor lead and feed stations, air-operated permanent magnets to separate blanks, and three-head transfer carriage. **Automation Machines & Equipment Co. Inc.**, 3125 W. Mill Rd., Milwaukee 9, Wis.

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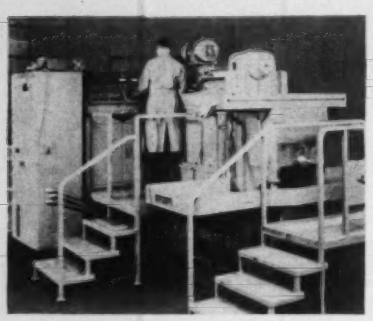

Gun-Drilling Machine

Numerical tape controlled gun-drilling machine, designated the Boremation Electra, is an automatic point-to-point machine capable of drilling precision holes with close tolerance positioning at a rapid cycle rate. It drills precision holes up to 36 in. deep (2 inches in diameter) in one stroke with 28 in. cross traverse and 18 in. vertical travel. Three methods are employed to actuate mechanical movements of the unit. Full automatic tape control is used for complex positioning and drilling operations, large or limited production, and prototype work. Semi-automatic dial control is ideal for a small number of parts of simple hole patterns. Manual control will simplify preproduction setups. The gun-drilling power unit, Model 3600 is capable of gun-drilling precision holes in one stroke from the solid. A mechanical transmission controls the feed rate. This transmission incorporates a separate drive mechanism for both feed and spindle. Additional versatility is available with the adoption of special power units with strokes up to 72 in. dual or multiple spindles with provision for performing boring, drilling, counter sinking, reaming, tapping, trepanning, and gun-boring. **Drillmation Co. Inc.**, 6500 E. Eleven Mile Rd., Center Line, Mich.

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Electronic Control System

Designated the M-Line temperature control loop, this miniature electronic control system provides all of the required instrumentation to measure and control a furnace. It offers maximum flexibility in operation with provisions for integrating data-handling and computing equipment. Instruments used in the loop include a temperature transmitter; single-pen Speedomax M recorder; a control system using a controller, set-point unit and automanual station; and a magnetic amplifier. System uses a 0-4 ma dc or a 1-5 ma dc standard signal. **Leeds & Northrup Co.**, 4934 Stenton Ave., Philadelphia 44, Pa.

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Servo Valve Test Stand

Hydraulic flow rates of as low as 100 drops per minute are plotted continuously without recycling on this servo valve test stand. Model 2784 will automatically record in X-Y form combinations of flow, piston force, pressure, and displacement. Design feature of the stand is a motor-driven spool displacement device with a linear position accuracy of 0.0001 inch. Fluid flow data is provided by a Series 2800 high accuracy flowmeter. Accuracy of the flow system is $\pm 1/4$ of 1 per cent of the instantaneous reading. System capabilities of the test stand: Flow 5 cc/minute to 1000 gpm; force 0.1 gram to 5 tons; displacement 0.0001 inch increments to any amplitude; pressures to 5000 psig. **Auto-Control Laboratories Inc.**, 5251 W. Imperial Highway, Los Angeles 45, Calif.

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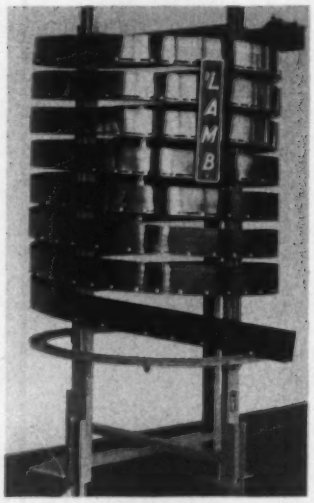

Storage and Lowering Unit

Helical unit part storage and lowering unit is used to provide gravity flow bank of parts at machine input in automatic parts handling installations. It is applicable to installations for production of such parts as pistons, bearings, blanks, and similar parts with rolling or sliding characteristics. Part flow through the unit is gravitational and constant. Critical surfaces of finished parts are protected by the inherent rapid deceleration provided by the first turn of the helical path and the braking action set up by centrifugal force of the part against the outer rail of the track. Other applications include storage and/or banking of parts at machine

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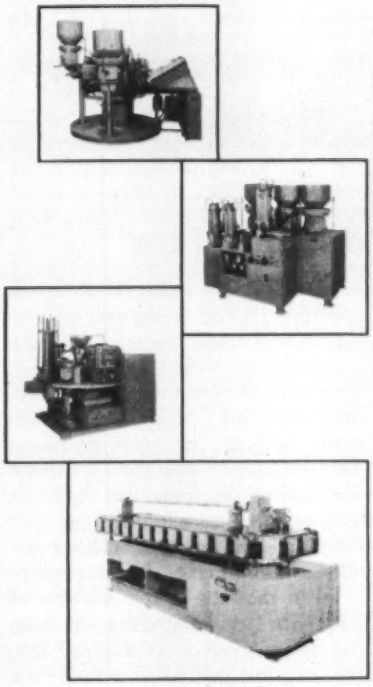
We are in a position to best serve those companies who require top quality dependable complex equipment to produce in large volume with a high degree of mechanical reliability.



Swanson-Erie capabilities encompass a wide variety of products and services which include: *standardized indexing machine chassis in many types and sizes; the manufacture of special machines to customers' designs; an integrated service which encompasses the complete functional responsibility for special machine projects from design to final testing and development; the manufacture of proprietary machines for the high speed production of incandescent and fluorescent lamps, radio tubes, glass and electronic components.*

All are built to the most exacting standards of quality and reliability. All carry a guarantee of complete parts interchangeability.
We welcome the opportunity to personally discuss special machine projects with firms seriously considering the use of automatic production equipment. And, we will be pleased to submit a proposal on those projects which fit within our scope of activity.

A booklet of our products and facilities is available on request.

SWANSON-ERIE CORPORATION

SEC 814 EAST EIGHTH STREET • ERIE, PENNSYLVANIA

Creators of... Better Automatic Machines For Less Cost In Less Time

Circle 690 on Page 35

input or output to assure adequate supply of work to automatic processing equipment. It can also be used as a lowering device as well as a deceleration device where gravity fed parts attain high velocity. Unit has a minimum 10-inch diameter. Drive and control mechanisms are not required. Electrical part flow control and machine interlocks are available. Unit is nonjamming and self-cleaning of chips and foreign debris. Oil-drip rail is optional. It is available in floor type or suspended models. **F. Jos. Lamb Co.**, 5663 E. Nine Mile Rd., Detroit 34, Mich.

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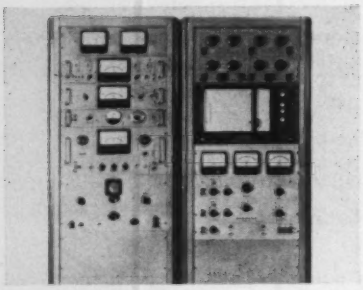

Servo Test Unit

Electro-hydraulic servo test unit automatically measures, displays, and records important static and dynamic characteristics of electro-hydraulic servo components. Parameters such as flow, pressure, pressure-differential, displacement, and current can be measured as well as frequency response, including amplitude ratio and phase lag. All measurements, both individually and combinations, can be visually displayed on meters or recorded on an X-Y coordinate plot. Designed originally for testing electrohydraulic servo valves, Model 810 can be used to test servo pumps, pump-motor transmissions, servo valve actuator packages, and other similar servo components. The necessary electronic instrumentation is contained in two separable, caster-mounted relay racks. The flow, pressure, and displacement transducers are provided separately with 20-foot cables for customer installation. **American Measurement & Control Inc., Subsidiary, Compu-Dyne Corp.**, 240 Calvary St., Waltham 54, Mass.

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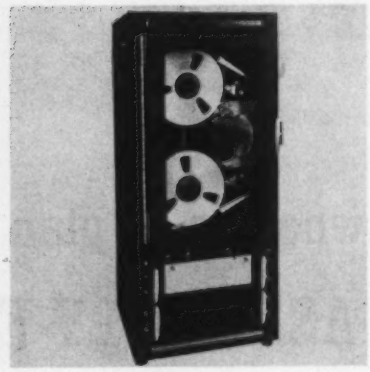

Digital Tape Transport

Low speed digital tape transport, Model DT 10, will read, write, or read after write tape traveling from 0.1 to 15 inches per second in specifically selectable speeds or continuously variable speeds controlled manually or remotely for any type computer format. Tape speed settings are held to within $\pm 1/4$ per cent independent of line voltage and frequency. Unidirectional or bidirectional fast stop-start modes are possible for all types of programs. Both fast forward and fast reverse modes are servo controlled for constant tape tension. Unit comes equipped with magnetic heads and precision tape guide assemblies. It can be equipped with file-protect and control device sensing compatible with all present day computer usage. **Shepherd Industries Inc.**, 103 Park Ave., Nutley 10, N. J.

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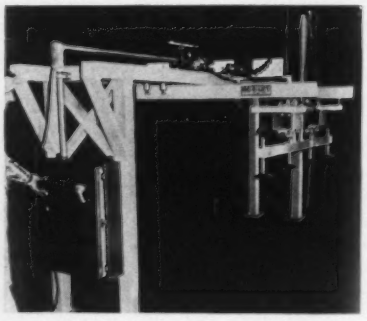

Sheet Feeder

Vacuum sheet feeding unit has been specially constructed to lift and feed fibre sheets into pinch rolls. Maximum weight of the fibre sheets is 100 lb. The feeder has a total lifting capacity of 500 lb. It may be adapted to any lifting-feeding operation involving relatively nonporous materials up to 96 inches wide and 140 inches long. It is a self-contained unit with integral wiring and power, control panel, air cylinder lift, and traverse with automatic, instantaneous vacuum attachment and detachment, plus a patented safety reserve system that holds the vacuum even if the power fails. This feeder is used to handle materials weighing from a few oz to several tons and such items as steel plate, tanks, concrete, structural steel, and glass. **Vac-U-Lift Co., Div., Siegler Corp.**, Salem, Ill.

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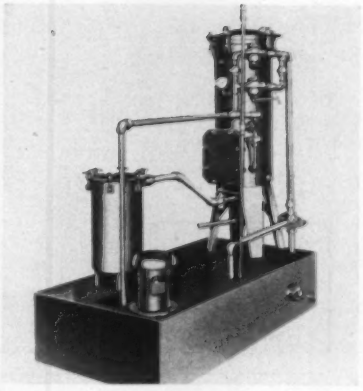

Machining Filter

Diatomaceous earth electrospark machining filter is capable of giving a very high degree of clarity at unusually low operating cost. Economy of operation plus quick, easy servicing permit big, long-term savings in manufacturing costs and production time. Instead of filtering oil from the receiving tank to the electrode only, the unit filters all oil supplies. This overall filtration makes it unnecessary to clean the base of the machine as frequently as when dirty oil from the upper reservoir is dumped into the machine base, as is normally the case when only the oil going up into the quill is filtered. Daily backwashing and precoating the filter creates what amounts to a new filter for each day's operation. **Olson Filtration Engineers**, Cincinnati 12, Ohio.

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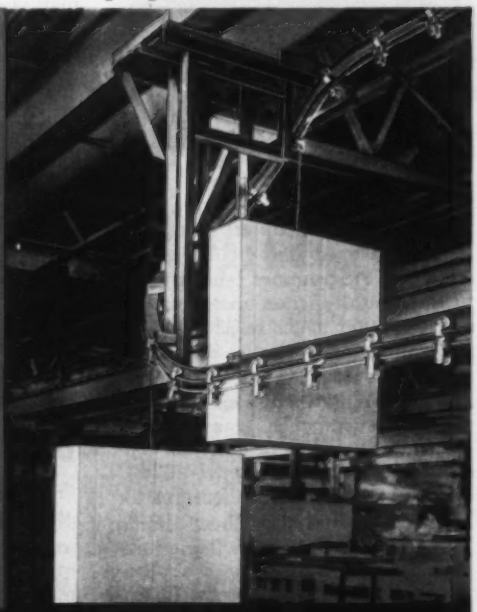
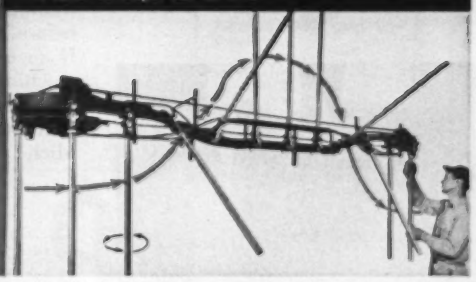
2 BASIC PATENT FEATURES

. . . . . with unlimited applications



Bush-Lock permits spiraled end turn for large parts clearance on close centered parallel tracks.

Bush-Lock's floating action permits trolleys to follow a special path while the cable travels in a straight line. No other conveyor can do this.



The low-cost efficiency that industry finds in long-lived Bush-Lock cable conveyors is obtainable in no other overhead system. For only Buschman patents cover these essentials: 1) straight-through continuous power cable—100-ft. lengths without a joint or link; 2) radially-free trolley alignment with track.

1. STRONG *PULLING* ELEMENT is the straight-through continuous cable . . . in 100-ft. lengths, with half buttons for quick coupling. Cylindrical buttons are swaged on cable, float free within trolley cavities, relieve any spiral twist and ensure true alignment with track. Only in Bush-Lock can the cable pull straight, even when path of trolleys and load is diverted. No restraining screws and clamps, no built-in strains, no links and wear points.

2. ROTARY *FLOATING* TROLLEY ACTION . . . Mating half section blocks bolt easily around swaged buttons to form cylindrical *cavity* in which the button rides free. This prevents cable strain of the clamped design. Trolleys align themselves without restraint. *The cable has factory built-in lubrication.* Bush-Lock cavity is pressure lubricated.

Bush-Lock features can be engineered to your needs, as they are in thousands of other plants. Get further details and see how they can serve *you.* Write for Engineering Data No. 52A, to The E. W. Buschman Company, 4551 Clifton Ave., Cincinnati 32, Ohio.

• • •

Buschman
CONVEYORS

Complete Conveyor Systems for all Types of Industries:
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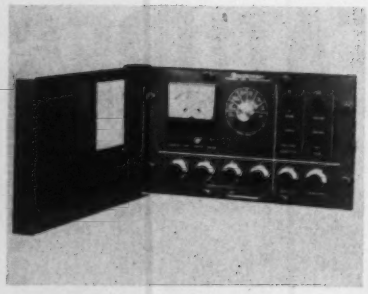
Circle 691 on Page 35



Gas Chromatograph

Process gas chromatograph, consisting of two modular units, has been developed for plant stream analysis. Programmer (shown) features a multifunction meter with a seven-position meter selector switch, positive visual indication of the disappearance of an analyzed component, means for readily checking the setting of component cams, and a dynamically balanced thermal conductivity bridge. Model 320-C analyzer offers optional features for high-speed analysis, direct liquid sampling, and hydrogen flame ionization detection for selected applications. **Scientific and Process Instruments Div., Beckman Instruments Inc.**, 2500 Fullerton Rd., Fullerton, Calif.

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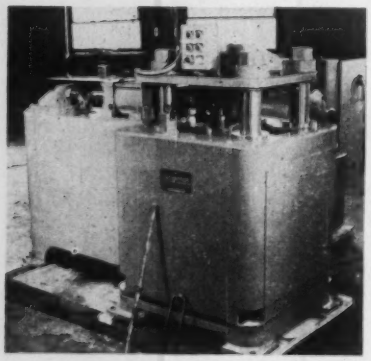

Hydraulic Press

Designed for bending bicycle fork forgings, this hydraulic press is suitable for single station bending of parts which currently require two or more press bending operations. Metal parts loaded into the machine are formed by a horizontal ram, a wrap around roller head, and a male forming die. Upon completion of the horizontal bend, a vertical ram rises carrying a female bending die to form the part in the vertical plane. After the bending operations are completed, an eject bar strips the part into a gravity chute. Production rates of the press are estimated to be 360 pieces per hour. **Automation Development Corp.**, 135 Reynolds Rd., Mentor, Ohio.

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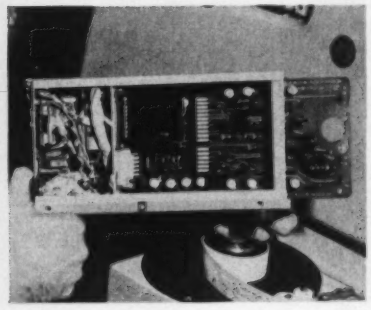

Digit Verifier

Electronic device, the A570 check digit verifier, has been developed to eliminate human error in encoding account and other reference numbers into punched paper tape. Attached to a line of accounting machines that produce tapes for subsequent data processing, the verifier instantly checks reference numbers entered on the keyboard before they are punched into tape. If an error is made, the accounting machine is stopped. **Equipment & Systems Div., Burroughs Corp., Information Services**, Detroit 32, Mich.

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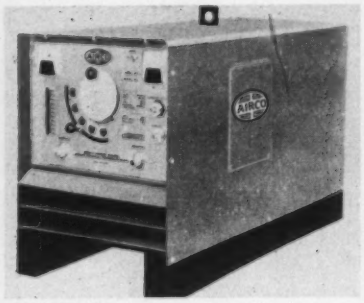

Tungsten Arc Welder

Machine, designated the Airco C-Bee Balanced Wave Heliwelder, is ideally suited for welding aluminum and magnesium using ac current. It features a balanced wave, transformer type power source; capacitor balancing; high open circuit voltage, 165 v, for maximum arc stability; five broad overlapping ranges for applications requiring 20 to 400 amp; good wave form in all ranges; electric control of amperage output for remote control with standard accessories; and power factor correction. Machine is rated at 300 amp, 100 per cent duty cycle. It is available in two models: For manual applications with gas and water controls and high frequency unit built in; and for semiautomatic and automatic operation with gas and water controls, but without high frequency unit. **Air Reduction Sales Co.**, 150 E. 42nd St., New York 17, N. Y.

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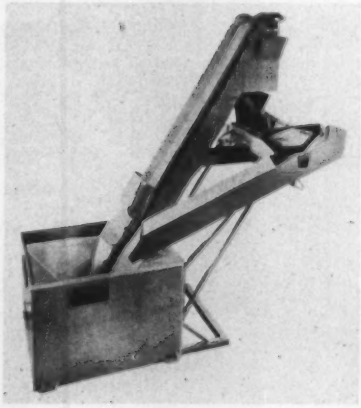

Parts Feeder

Present production rate of this engine valve feeder is 4000 to 6000 pieces per hour. Orienting is accomplished by a vibratory straight-line tuned frequency unit. This is supported under the elevator chute for over the top work discharge to the orientor tooling. Parts are quickly committed to the orientor tooling with an unusually low percentage of recirculation. Feature of tooling design is that it can be made adjustable. Not only will the unit feed and orient several sizes of valves, but is adaptable to handling connecting rods at 1500 per hour, headed and ball studs at 3600 to 7200 per hour, stampings, with predominate ears or flanges, and many similar applications. **Campbell Machines Co.**, 18634 Fitzpatrick, Detroit 28, Mich.

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9 questions you should ask about numerical machine tool controls

1

Has the system, through actual use, proven to be a money saver?

Many new controls on the market today have yet to be installed on their first customer application. However, Hughes numerical positioning controls have been successfully operating in customer plants for over a year and a half! One typical Hughes customer was able to cut tool costs by $3000 and reduce lead time by 50% on a run of 50 missile parts.

2

Is it competitively priced?

Many people are surprised that Hughes systems, with all their advantages, are often priced lower than competitive units.

3

How many machine axes can I control?

Hughes provides either two or three axis controls – in the same cabinet. And, with the Hughes system, you can purchase a two axis control now, and add the third later.

4

Are special skills required to prepare the tapes and operate the machine?

Not with the Hughes system. Anyone familiar with general machine shop practices can prepare the tapes and operate the machine after only two days training!

5

Can I get high accuracy — and, is that accuracy repeatable?

Hughes two-axis controls offer you repeatable accuracies of ±0.0002 inch with a resolution of ±0.001 inch. Adding the third axis, repeatable depth accuracies of ±.0005 with a resolution of ±0.001 inch can be obtained.

6

Will I need a great deal of service after sale?

Maybe you've heard about numerical control systems that require a lot of service. Not so when you specify a Hughes Numerical Machine Tool Control. Customers report that "up time" is over 95% – after a full year of operation!

7

Is the system transistorized for maximum reliability?

The Hughes Transistorized System is much less sensitive to vibration, shock and temperature fluctuation. Result: with Hughes transistorized circuitry you get higher reliability and minimum maintenance.

8

Is the tape reader fast and reliable?

Mechanical tape readers have two inherent disadvantages: they are relatively slow and they tend to deform the tape holes. Not so with photo electric tape readers – the type used on Hughes controls. They're extremely fast (eliminating need for costly electronic storage) and they do not injure the program tape.

9

Does the manufacturer have a reputation for standing behind everything sold?

Hughes gets an emphatic "yes" to this question. Hughes has built a reputation as a *world leader* in advanced electronics and has a world wide service organization.

Find out more about how Hughes Numerical Controls

can increase your profits. Write, wire, teletype (TWX INGL 4117) or call direct: Hughes Industrial Control Systems, Dept. No. 92-21, P.O. Box 90904, Los Angeles 45, California. For export information please write: Hughes International, Culver City, California.

CREATING A NEW WORLD WITH ELECTRONICS

HUGHES

HUGHES AIRCRAFT COMPANY
INDUSTRIAL SYSTEMS DIVISION

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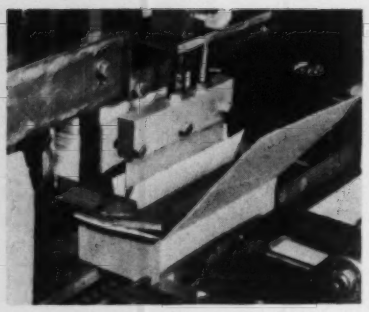

Divider Inserter

This attachment has been developed to automatically insert protective corrugated dividers between rows of cookies in cartons. It can be easily attached to all types of conveyor systems, and will insert protective dividers between any fragile or specially surfaced products. The prescored dividers are placed in the feeder mechanism in flat position. As the filled cartons move along the conveyor, they activate the inserting unit. The unit then automatically folds the prescored dividers, gently pushing them down between the rows of cookies in the cartons. **Peters Machinery Co.**, 4700 N. Ravenswood Ave., Chicago 40, Ill.

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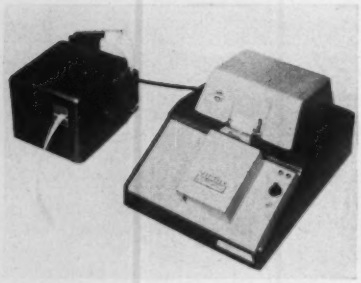

Data Punch

Digit-Matic data punch allows for remote control adding machine operation through the use of solenoids with both a printed detail tape and a punched data processing tape resulting. It can be activated from distant points by a wide variety of associated equipment, and can be programmed by equipment now programming other digital handling or data processing units. Such devices as digital converters, communications systems, control instruments, digital counters, and temperature recorders can be used to activate the data punch. Simultaneously from each such operation comes a printed record for immediate information, plus punched tape for further automatic handling. The punched tape contains coded information in 5, 6, 7, or 8 channels. Punched tape output can be used to plot curves, transmit data via wires to a central office, and accumulate inventory figures. Complete line includes both a 10-key serial entry model and a parallel entry full keyboard machine. **Victor Adding Machine Co.**, 3900 N. Rockwell St., Chicago 18, Ill.

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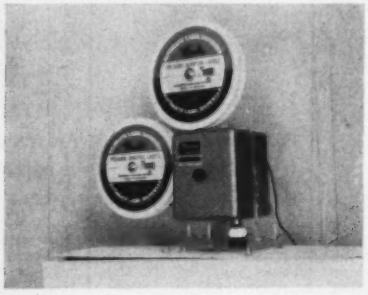

Automatic Labeler

Pressure-sensitive labels may be applied at high speeds with extreme accuracy to any type of surface by this compact Tuck labeler. Machine labels surfaces which are soft or hard, concave, convex, or even deeply recessed, with a precision of ±0.010 inch. It can be adapted in less than five minutes to handle any size or shape of label up to three inches square of area. It can handle foil or thin films. A printing attachment is available which will print prices, or four lines of type, on the labels as they are applied. Labels are applied by means of self-adjusting plunger which picks up the label from the roll, then reaches out and fastens it to the desired surface. Up to 15,000 labels can be applied from one loading. The labeling operation itself takes only $\frac{1}{8}$ of a second, and a bank of machines can be arranged to apply 480 labels per minute on a single assembly line. **Technical Tape Corp.**, 240 North Ave., New Rochelle, N. Y.

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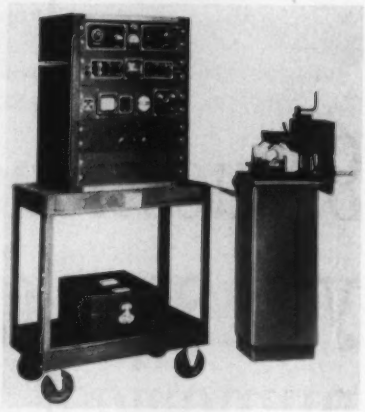

Flaw Detector

Single frequency nondestructive testing equipment employs an oscilloscope presentation to indicate surface or subsurface flaws in nonferrous, nonmagnetic materials. The equipment is equally adaptable to production line use, or a separate inspection operation. At inspection speeds of 50 to 600 feet per minute, materials $\frac{1}{8}$ to 3 inches diameter can be inspected. Twenty-four plug-in coils adapt equipment for interim sizes in $\frac{1}{8}$-inch increments. Input and power supply panel provides regulation for the 110 v, 60 cycle single phase current, and the B+ supply. **Magnetic Analysis Corp.**, 42-44 Twelfth St., Long Island City 1, N. Y.

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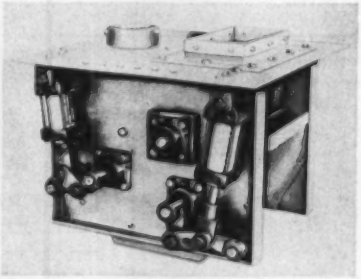
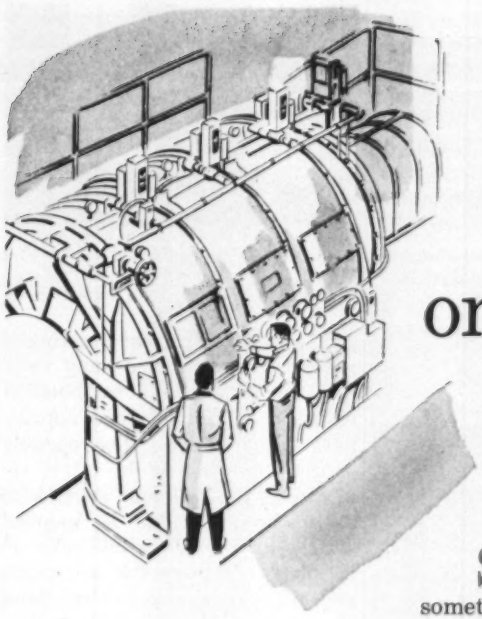


Rotary Feeder

Vane type feeder, designated Series R, is engineered to accurately feed flour, P.V.C., and burnt lime and is particularly suited for materials that aerate and flood. A motor driven rotor controls feed rate, and a pneumatically operated control gate provides positive shut-off of material flow. Four models



There's more than one kind of Dynamatic service!

Some folks think of "service" as the help you need when something goes wrong. That's important, of course, and Dynamatic supplies it with competent service representatives located in principal cities throughout the United States and Canada. In addition, around-the-clock seven-days-a-week service is available from the factory.

But there's another kind of service that's equally important—the service that starts even before you have purchased Dynamatic speed control equipment. It's being able to sit down with your Dynamatic representative, knowing that he has very likely been up against a problem about the same as yours before; that he has a background gained through years of experience in this specialized field.

Dynamatic service begins with your first inquiry, includes start-up supervision by factory service engineers, and follows through for the life of the equipment.

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are available, three of which are two-speed, employing dual rotors and gates. The models handle from 3.0 to 35.0 cfm at 75 per cent efficiency. **Thayer Scale Corp.**, Thayer Park, Pembroke, Mass.

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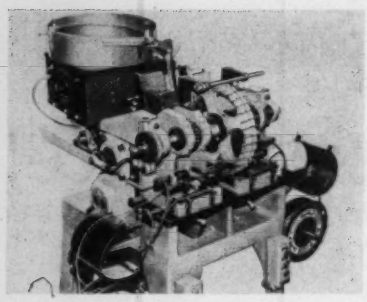

Tip Applying Machine

Machine was designed for applying tips to component leads. It applies terminals to loose piece components at the rate of 7200 tips per hour to 3600 components. Prior to tipping, the machine trims component leads to desired lengths, then, after tipping, bends these leads to a 90-degree angle for insertion in printed circuit boards. Bending can be made anywhere along the length of the component lead so that the lead on either side of the component can be bent at a different point. **AMP Inc.**, Harrisburg, Pa.

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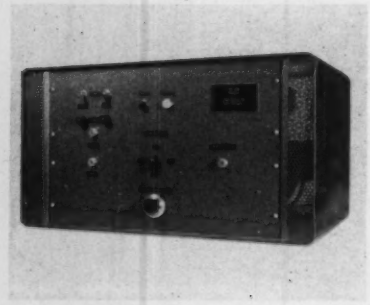

Time Reader

Automatic diode recovery time reader has been developed for the JAN 256 circuit of the modified I.B.M. "Y" circuit. All decisions are done electronically and the output consists of a red (no-go) or green (go) light. The go-no-go limits are easily set on a precision potentiometer. The output is in the form of a contact closure which can be used to provide a control circuit for automatic handling equipment. Reader specifications are as follows: Speed, 4000 parts/hr; reverse voltage range, 5 to 40 volts; and sensitivity, 100 mv. **Contronics Inc.**, 37 Leon St., Boston, Mass.

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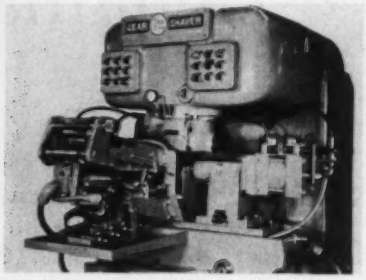

Parts Loader

Slide-type loader permits unsymmetrical parts to be easily and accurately gaged for size before entry into an input chute. It can be used to feed and unload parts from rotary gear shaving or gear tooth honing machines and is ideally adapted to the handling of such parts as transmission clutch gears. The lower master gear of the machine is equipped with radial fingers on which the shaft portion of the gear rests as it is being passed through the gaging master gears. The Red Ring loader illustrated handles 2.196 in. pitch diameter by $8\frac{3}{16}$ in. long clutch gears at a rate of 160 pieces per hour at 100 per cent efficiency. **National Broach & Machine Co.**, 5600 St. Jean, Detroit 13, Mich.

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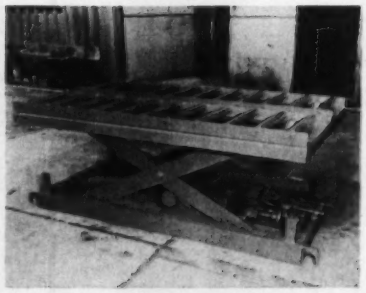
Hydraulic Lift Table

Nonelectric hydraulic lift table is appropriate for use in hazardous locations where explosive conditions are a concern. It is lifted by a hydraulic system. The pump which impels the oil to the system is driven by an air motor that operates from an air supply line. The absence of electricity extends to the control equipment also, in that lowering is effected by means of a hand valve that diverts air to a combination miniature air cylinder and normally-closed air valve. The opening of this valve allows the oil to return from the hydraulic cylinder to its reservoir. Table is supplied with a filter-regulator-lubricator to be placed between the air source and the hand valve. **West Bend Equipment Corp.**, West Bend, Wis.



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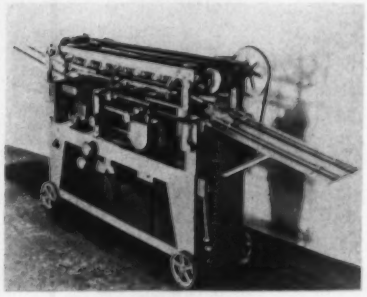
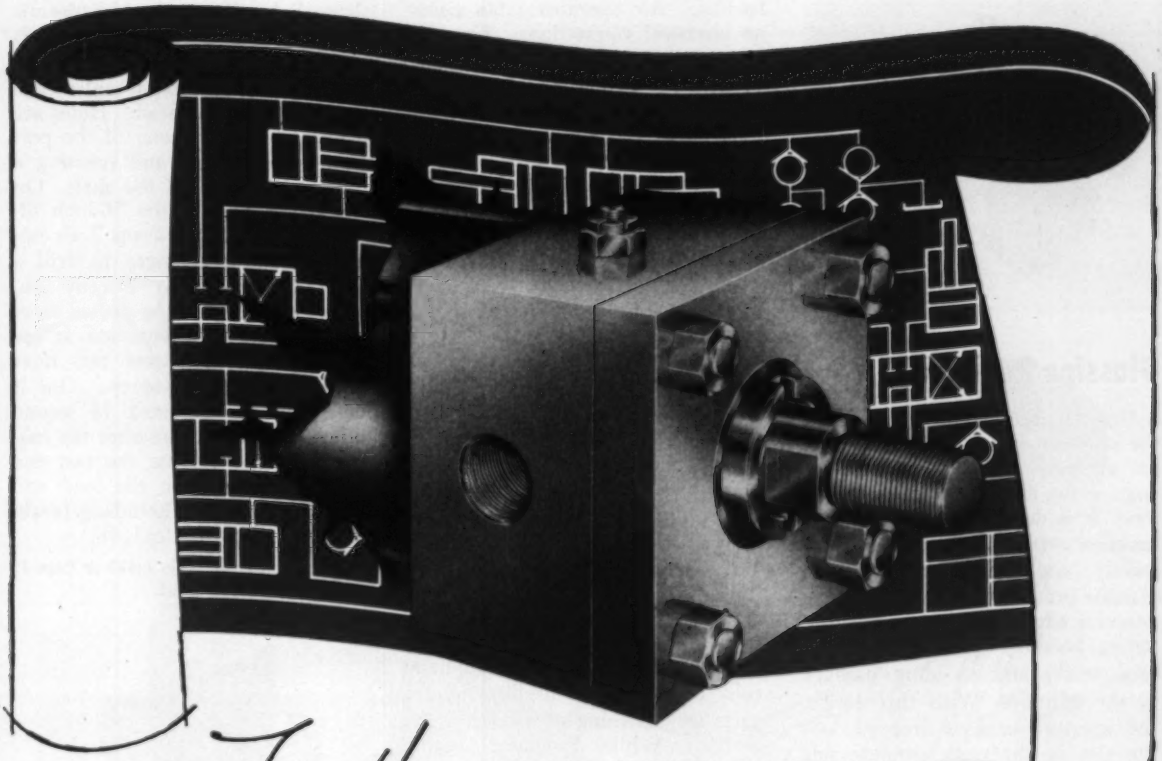


Container Labeler

Machine is designed for wrap-around or spot labeling of cans, glass, and aerosol containers. It is capable of speeds up to 1000 units per minute and is equipped with a stainless steel paste belt that is quickly removable for cleaning. This paste belt does not drag on labels during interruptions to supply of containers. A quickly removable paste pot is stationed on operator's side of the machine for better access. The label box is adjustable at each end allowing precise adjustment even when labels are trimmed crooked. Self-leveling main and auxiliary label beds automatically compensate for varying thickness in labels due to printing, both endwise and crosswise. **Crompton & Knowles Packaging Corp.**, Holyoke, Mass.

Circle 429 on Page 35



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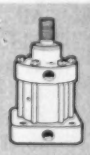
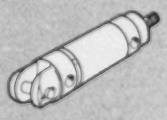
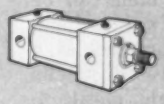


STANDARD HYDRAULIC

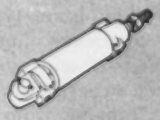
STANDARD PNEUMATIC



AIR and HYDRAULIC SPACEMAKER



AIR and HYDRAULIC SQUAIR HEAD



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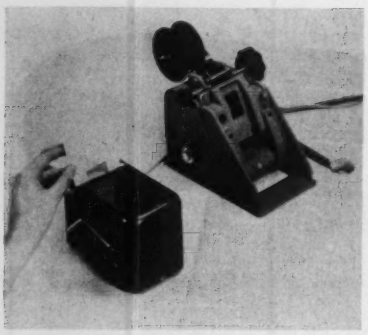
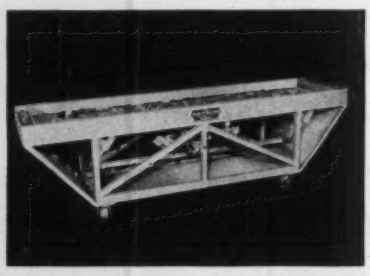
Circle 694 on Page 35



Glassine Remover

Unit has been developed to speed the precision mounting of microfilm on aperture cards in automating engineering drawing production systems. It is designed for use in conjunction with a mounter and instantly and clearly removes the glassine protective covering from the adhesive edge of an aperture, eliminating bending or crimping of the card stock, and avoiding damage to the adhesive. With this device, the aperture card is dropped into the slot in the unit, window side first. The glassine is removed the instant the operator touches the operating lever. The card is then removed, ready to receive the microfilm image. **Dataflow Inc.**, 151 Bevier St., Binghamton, N. Y.

Circle 430 on Page 35



Portable Transfer Table

Walking-beam type table can be used to convey almost any size and shape part and can also act as a mobile storage unit. It will handle parts ranging from light plastic to steel castings of several hundred pounds. Open grid construction of table top makes it ideal for handling oily parts or for use in handling hot castings. Table speed is adjustable within wide limits. A transfer table of proper length can be used between two machines for continuous feeding. Air operated table needs no electrical connections. **Gear-O-Mation Div., Michigan Tool Co.**, 7173 E. McNichols Rd., Detroit 12, Mich.

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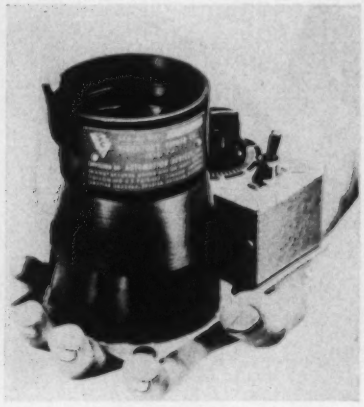

Vibratory Feeder

Unit is engineered for automatically orienting and feeding minute parts for matching or assembly operations. While developed specifically for watchmakers, optical, and electronic industries, current indications are that it has a wide application in many other fields. Model 3 base unit and 3-inch molded bowl are complete with a rheostat variation control, and *On* and *Off* switch. The bowl will handle disc shaped parts from the smallest diameter to 1/8 inch and cylindrical shapes with length variations up to 5/16 inch. **VFC Div., Automation Devices Inc.**, Erie, Pa.

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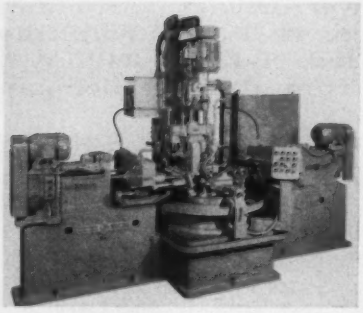


Drill and Reamer

Four-station automatic indexing machine to drill and ream automotive rocker arm shafts employs three R-J self-contained hydraulic quill units. The vertical unit is equipped with a 12-spindle head and the two horizontal units each have a 14-spindle head. Holes are drilled on the diameter of the part as well as drilling and reaming a hole in each end of the shaft. On the center post of the 36-inch diameter index table, a small air operated quill is arranged to drill a 5/16 diameter hole directly opposite the holes being drilled from the horizontal. Production is approximately 200 pieces per hour at 100 per cent efficiency. This is based on an estimated 18 second unload and load time after the machining cycle because the two end holes are reamed in the load and unload station. **Rehnberg-Jacobson Mfg. Co.**, Rockford, Ill.

Circle 433 on Page 35

Tape Punch

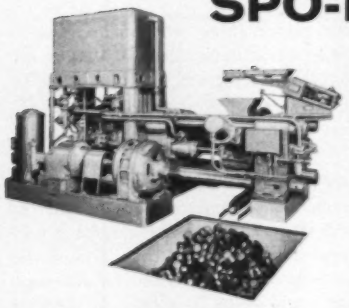
Designed to produce alpha-numerical coded tapes for use as data input means for a numerical control system, Model TP-1 tape punch employs standard eight-channel code. All decimal codes plus alphabetic address codes S, T, U, W, X, Y, Z, as well as end line (carriage return) and tape feed codes can be produced. The keyboard is connected to the punch by means of a multiconductor cable and plug-in connector. Punches for nonstandard codes can be furnished. Power requirements of the device are 110-120 v ac single phase. **Carlton Controls Corp.**, 15 Sagamore Rd., Worcester 5, Mass.

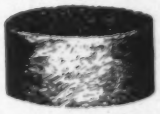
Circle 434 on Page 35

"Briquette this stuff and we can sell it at a profit!"

. . . with a

SPO-MILWAUKEE briquetting press!

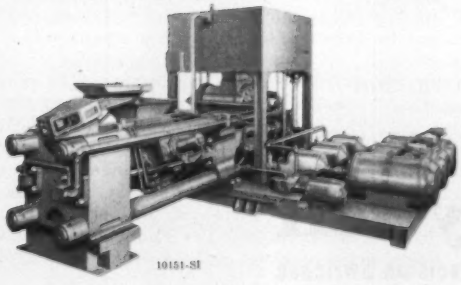




As the metal working industry increases machine tool speeds . . . as automation techniques facilitate faster production . . . more and MORE chips, turnings and borings are formed.

Briquetted scrap sells for more money . . . and this means a briquetting press is a profit making machine . . . a profit unit that operates virtually "operator-free." The advantages of briquetting go even beyond profit. Your scrap will require less storage area. Briquetted scrap is easier to handle . . . cheaper to ship . . . faster to dispose of.

If your machine tool scrap ranges from 4 tons per day to 9 tons per hour, there is a Milwaukee briquetting press that will bring profit to your scrap problem.



10151-SI

We strongly urge you to write today for Bulletin BP-217. It will provide you with all the facts. Send your inquiry to . . .

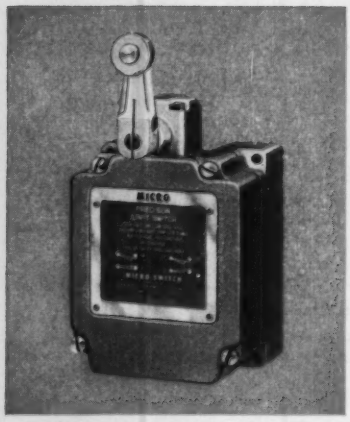
WORLD'S LARGEST SUPPLIERS SPO OF MOLDING MACHINES

MILWAUKEE *Foundry Equipment Division*

6306 Grand Division Avenue • Cleveland 25, Ohio

Circle 695 on Page 35

Neon Check Light Signals Operating Position!



New "301LS" is another in MICRO's line of "Plug-in Limit" Switches. This model contains 2 basic switches, each with a normally open and normally closed circuit.

The new "LS" Limit Switch has a translucent plastic insert and enclosed neon light that tell at a glance whether the switch is functioning. Perfect answer for checking switches that must be located in inaccessible or poorly lighted areas, or where it is important to be able to check a large number of limit switches on a production line in minimum time. The new switch is an addition to MICRO's line of compact, high capacity "LS" limit switches.

New "301LS" has two basic switches which are operated when the actuating lever is moved clockwise or counterclockwise. Internal adjustments are easily made to provide sequence operation of the two enclosed switches. Sequence control is useful on tool slides to 1) switch from rapid traverse to feed rate and then 2) with the second switch, return the tool to the original position. Sequence control is also used as a positive limit stop where machine damage could occur by a fault in the first switching circuit. See the Yellow Pages for your nearby MICRO SWITCH distributor or write for Data Sheet 187.

MICRO SWITCH . . . FREEPORT, ILLINOIS
A division of Honeywell
In Canada: Honeywell Controls, Limited, Toronto 17, Ontario

Honeywell
MICRO SWITCH Precision Switches

Circle 696 on Page 35

AUTOMATION **new components**

For detailed information and literature, use card page 35.

Parts, elements and devices designed for creating more automatic systems.

High-Speed Process Vapor Fractometer

HIGH-SPEED gas chromatographic system has been designed by **Perkin-Elmer Corp.**, Main St., Norwalk, Conn., in co-operation with Phillips Petroleum Co. for use on multicomponent process streams. Typical uses of Model 284-B include monitoring and closed-loop control of: Distillation tower fractionators; alkylation reactors; hydrogen sulfide to sulfur dioxide ratio in sulfur recovery plants; and oxygen and carbon monoxide in regenerators of catalytic cracking plants. Instrument delivers control signals of 0 to 4 milliamperes, 0 to 50 v, proportional to the concentrations of measured components. When used with milliampere to psi transducer, it is suitable for duty in pneumatic control systems.

System incorporates a sensing unit and a multicomponent peak reading controller. A high-speed pneumatic valve in the sensing unit introduces gas samples into the chromatographic column in less than one second. The sample passes through one or more columns, which separate it into its components. The components are eluted into a special detecting and measuring unit. Carrier gas flow rate and analyzer temperature are both closely controlled to assure stable, reproducible results. All sensing unit functions are controlled and actuated by a programmer, which is a component of the peak reading controller. The other major part of the controller is a memory and transmission unit. This unit performs two basic functions. It receives, selects, and stores only the peak values of the component signals transmitted, and it later amplifies and transmits segregated peak values separately, according to commands from the programmer. The transmitted signals

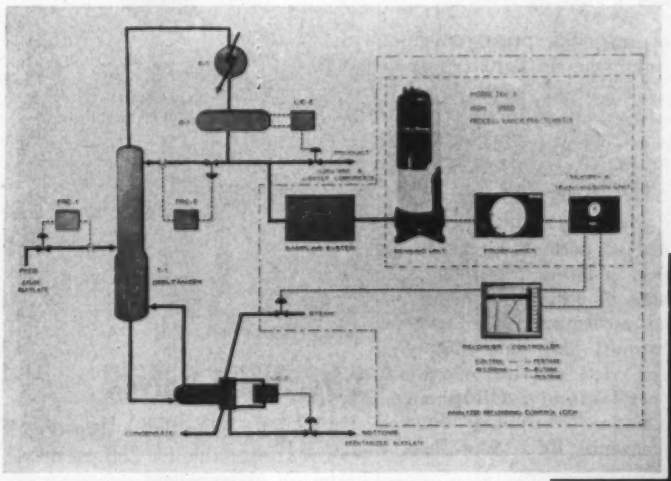
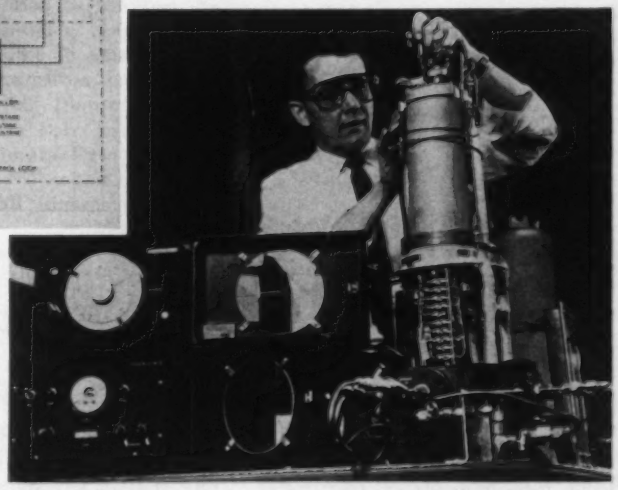


Diagram illustrates use of high-speed process vapor fractometer to control the concentration of isopentane in a debutanizer overhead product. Debutanizer is part of an alkylation plant which receives the crude alkylate. Since it is desired to recover all butanes and minimize pentanes in the overhead, both n-butane and isopentane are monitored. This combination for control and monitoring purposes allows maximum butane recovery at optimum tower performance. The analysis of n-butane and isopentane is performed once every minute and allows this unit to be installed in control loop without intermediate or cascade controllers.



High-speed chromatographic system enables closed loop control in process industries. Analyzer unit is at right. Upper unit at left is programmer; lower unit at left is memory and transmission unit.

are available for both control and data recording purposes.

Features of the system include column backflushing to speed component separation and analysis; automatic sample cut-off to protect the columns against damage in the event of air supply failure; easy access to the detector unit for cleaning and maintenance; a simple function selector switch that controls all functions of the analyzer; and an easy-to-adjust master timing dial using color-coded tabs. A peak meter and peak light give visual evidence of proper analyzer functioning and greatly facilitate programming.

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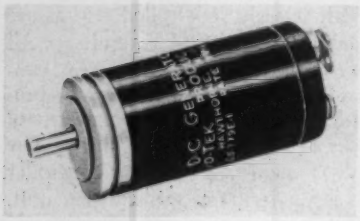

Tachometer

Unit, designated Model SS-779E-1, weighs less than 1½ oz and has an over-all diameter of ¾ inch. Armature inertia is 3.5 gm-cm². Tachometer is available with an output of 3 v per 1000 rpm. Value of the ripple does not exceed 3 per cent of the dc output. Unit has an aluminum housing with protective treatments and a commutator of nearly pure silver. Stainless steel shaft of the armature rotates on fully shielded grease-lubricated ball bearings. **Servo-Tek Products Co.**, 1086 Goffle Rd., Hawthorne, N. J.

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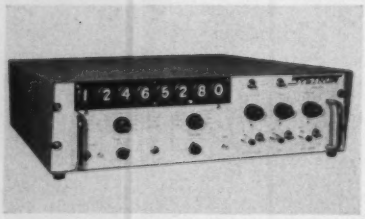

Counter-Timer

Transistorized counter-timer provides measurements of frequencies from 0 to 10 mcps, time intervals and periods from 0.3 microsec to 10^8 sec, frequency ratios to 10^7, and phase measurements direct to 0.1 degree. Model 1039 provides features of Nixie In-Line Readout, 3 dc amplifiers all with 1 megohm input impedance—0.1 Vrms sensitivity. Power consumption is 50 watts, and plug-in printed circuit boards are used to make the unit ideal for production testing where reliability and ease of maintenance are prime requisites. **Systron Corp.**, 950 Galindo St., Concord, Calif.

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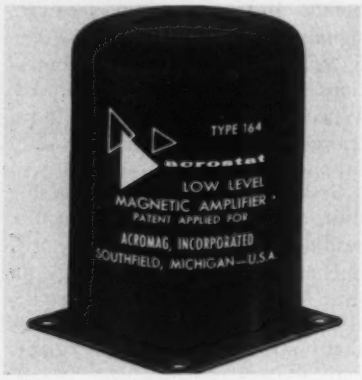

Magnetic Preamplifiers

Series of magnetic preamplifiers detect 10 microvolt dc signals from thermocouples, strain gages, Hall generators, and other low-level dc signal sensors. They are completely self-contained and require less than 3 watts at 115 volt ±10 per cent power for operation. These units are designed to perform as an input chopper, isolation transformer, several stages of amplification, and a regulated power supply. Designated Acrostats, they are highly reliable and designed to operate for years without any adjustment or maintenance. **Acromag Inc.**, 22515 Telegraph Rd., Southfield (Detroit), Mich.

Circle 438 on Page 35

Air Dryer

Noncycling air dryer, designated Series-E, is designed for the protection of pneumatic controls. With a rated capacity of 10 scfm at 100 psig, it is ideally suited for air conditioning and ventilating control

systems, printing press and other pneumatic feeds, processing and production lines, and many laboratory applications. The unit drys air and gases by mechanical refrigeration. No cooling water is needed, and ambient temperature variance problems are eliminated. The dryer is available as a basic unit (no trap), Model E-10; with the Mag-Pneu-Power automatic trap, Model E-10T; or with the Armstrong 21 trap, Model E-10C. **Hankison Corp.**, College and Dike, Canonsburg, Pa.

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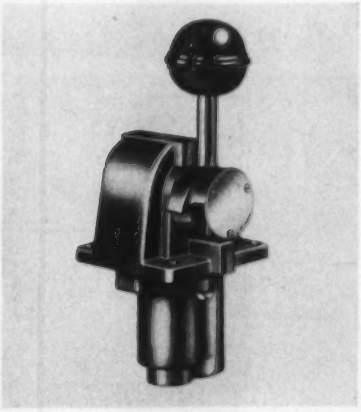
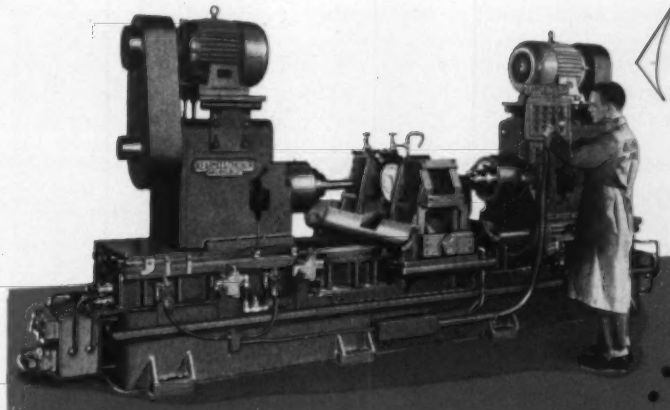


Directional Valves

Panel mounting directional valves are suitable for 250 psi maximum air pressure and temperatures from −40 to +200 F. Single unit valves are normally closed or normally open for three-way operation. Double unit valves provide three types of four-way operation. An all purpose operating cam may be rotated to change operation from one function to another. Essentially all die cast zinc for corrosion resistance, the valves contain hardened sintered steel cams. Seals



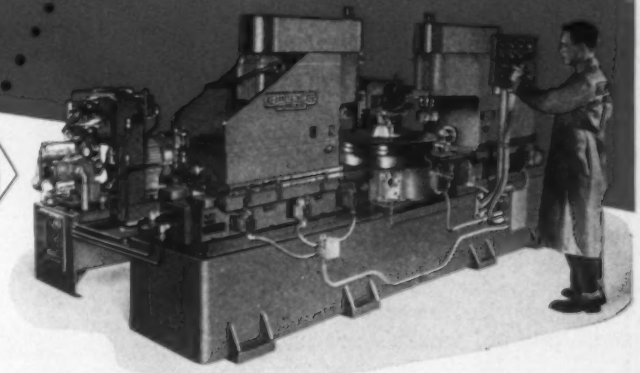
CONSTRUCTION INDUSTRY

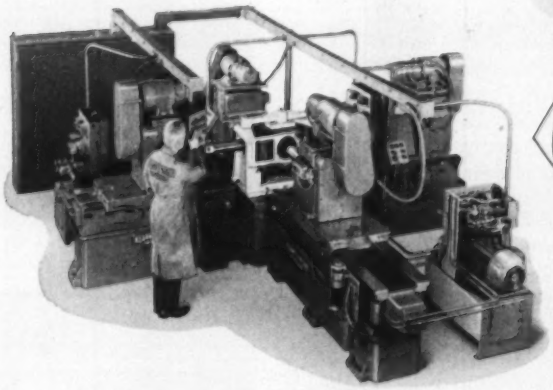
Only one setup is required to rough and finish bore, finish counterbore and face both sides of a tread roller for tractor-type construction equipment. Workpiece is hydraulically clamped . . . seven sizes of rollers can be machined. This method replaces a turret lathe using two setups. New rate is 13 pieces per hour.
Production up — 100%.

Kearney & Trecker builds PRODUCTION MACHINE TOOLS FOR EVERY INDUSTRY

AIRCRAFT INDUSTRY

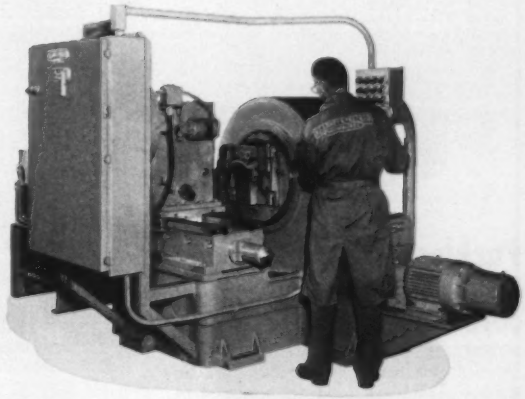
Rotary feed, bed-type machine with two opposed vertical spindles mills both sides of aluminum pump body flange to critical thickness and smooth finish *at rate of 76 pieces per hour.* Unit is versatile . . . as many as eight types of pump bodies are milled using only separate fixtures and cams.





ENGINE INDUSTRY

This unit bores four holes in engine block simultaneously . . . replaces horizontal milling and boring machine that worked just one hole per setup. Interchangeable inserts allow operations on any of four different workpieces. One feed slide unit handles interchangeable heads.
Production — 10 pieces per hour . . . up — 400%.



ELECTRIC POWER INDUSTRY

Two-spindle machine mills both inside and outside radii of curved alloy steel turbine blade section in a single pass *at three times the former feed rate.* Versatile 360° drum fixture handles 81 different blade sizes without overtravel on rapid stroke for extremely short cycle time.
Production up — 300%.

Write for bulletin SMD-57 on your company letterhead or phone — GReenfield 6-8300 . . . Direct Distance Dialing Code No. 414.

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SPECIAL MACHINERY DIVISION

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SINCE 1898 . . . *Kearney & Trecker Customer Engineering Service — supported by an outstanding staff of engineers experienced in production milling machine design and application — combined with the finest and latest machine tools in an ultra modern plant, is always ready to solve your production problems.*

and seats are oil resistant synthetic rubber. **Industrial Products Div., Westinghouse Air Brake Co.**, Wilmerding, Pa.

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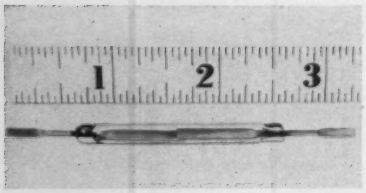

Magnetic Reed Switch

Rated at 15 volt-amperes maximum, resistive up to 1 ampere, magnetic reed switch operates in any position and is hermetically sealed for safe, reliable use under any atmospheric conditions—wet or dry—even where the danger of explosion exists. It is not affected by extremely high or low temperatures or pressures. Model DRG-1 is used for such applications as electromagnetic relays, position indicators, counting instruments, limit switches, and flow meters. Switch can be provided normally open, normally closed with bias magnet, or with a latching arrangement. **Hamlin Inc.**, Lake and Grove Streets, Lake Mills, Wis.

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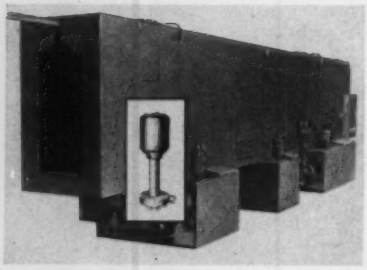

Packless Pumps

Heavy duty, vertical packless pumps are designed to minimize power spray phosphatizing washer breakdown and production loss. Solution attack on packing seals of externally mounted horizontal pumps and resulting external washer leakage are eliminated because the pumps are submerged and packless. Vertical placement eliminates motor damage by solution spray, a constant danger when horizontal pumps leak. Other advantages: Operation at lower pressures; enlarged spray manifolds and minimum piping reduce pressure losses in the system. Nozzle pressure remains high, with lower hp. **Ramco Equipment Corp.**, 1379 Lafayette Ave., New York 59, N. Y.

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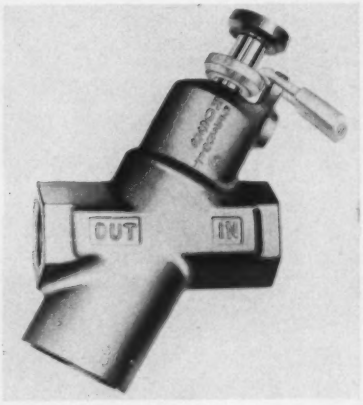

Locked Valve

Lock out and exhaust valve is capable of being padlocked in closed position to cut off air supply to a machine or to portions of a circuit for added safety during repair or shutdown periods. Air downstream of the valve is exhausted. Detented in the open position, the valve is designed for very low pressure drop. It is available in four sizes for $\frac{3}{8}$ to 1-inch pipe. Area through the valve is greater than the interior of the standard pipe for which it is tapped. **Ross Operating Valve Co.**, Detroit, Mich.

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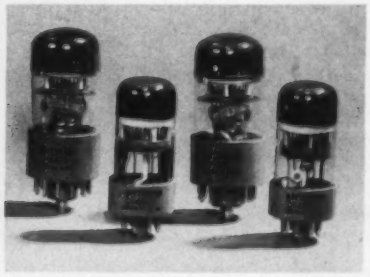
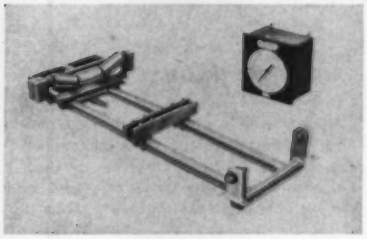


Counter Tubes

Cold cathode bidirectional ring stepping decade counter tubes are capable of counting up to 100,000 pulses per second. Tubes feature direct visual neon glow readout or electrical readout in the form of a voltage from any of the cathode leads. Negligible power dissipation, short resolution time, simple low cost circuitry, and no moving parts make these tubes very reliable counter devices. Some of the many uses include counting, timing, sampling, frequency dividing, coding matrixing, telemetering, and controlling. The CK6909 and CK6910 decade counters operate up to 100kc, and the CK6802 and CK6476 operate up to 4kc. **Industrial Components Div., Raytheon Co.**, 55 Chapel St., Newton, Mass.

Circle 444 on Page 35



Conveyor Scale

Device automatically weighs, measures, meters, and/or controls the flow of bulk materials on conveyor belts. Designated the Vey-R-Weigh, this scale is designed for control applications in operations where bulk materials are transported on conveyors. It is adaptable to many measurement, control, and recording operations such as a continuous product inventory, rationing or blending of additives, segregation control, bulk destiny determination, grade or assay determination, or the control of feed rates to processing equipment. Various types of controls can be provided for remote recording by tape or punched card readout. A remote indicating and recording instrument may be mounted in any convenient location up to 500 ft from the carriage. Adjustments for zero and calibration are contained within the instrument, and a range of full scale capacities from 8.6 to 250 lb per foot of belt is available for standard models. **Ramsey Engineering Co.**, 1853 W. County Rd. C, St. Paul 13, Minn.

Circle 445 on Page 35

automatic spray from DeVilbiss gives you control and uniformity not possible by other methods for applying paints, adhesives, glazes; marking, stenciling. It's part of a complete line of matched equipment for coating and finishing: spray guns, dip and flow coaters, spray booths, air and fluid hose, ovens, spray washers, air-replacement units, dust collectors, "turn-key" finishing systems.

Talk to DeVilbiss about all your automatic spray-coating needs

FOR TOTAL SERVICE, CALL
DEVILBISS

THE DeVILBISS COMPANY, Toledo 1, Ohio. Also Barrie, Ontario; London, England; São Paulo, Brazil. Branch offices in principal cities.

Circle 697 on Page 35

INFRARED

IN...ON...OVER...UNDER...AROUND—FOSTORIA OVENS BAKE FINISHES FAST REGARDLESS OF PRODUCT SHAPE

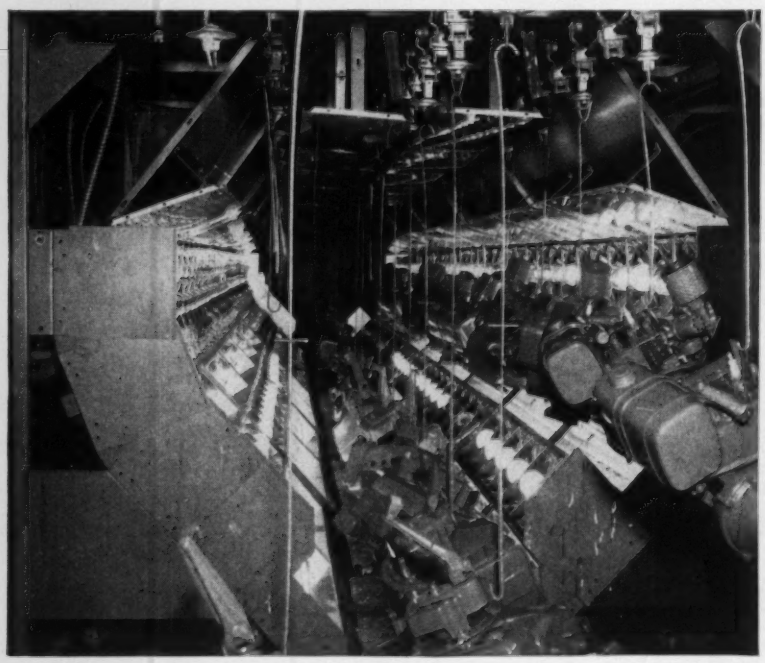
Irregular product contours and varying metal thicknesses make it tough to properly bake enamel finishes uniformly. Runs, soft spots, thin spots and over baking are commonplace, resulting in poor appearance and customer dissatisfaction. But Clinton Engines Corporation of Maquoketa, Iowa and Clinton, Michigan have solved the problem with the pictured installation of Fostoria Infrared Drying Ovens.

Because Fostoria Infrared ovens are designed to direct heat to **all** surfaces evenly and quickly, Clinton engineers find 50% fewer rejects due to improper finishing. In addition, they have cut drying time by 50%. They are saving 15% on paint material costs.

As though this weren't enough, they are finding equally successful results on such diversely shaped products as engines, chain saws and outboard motors.

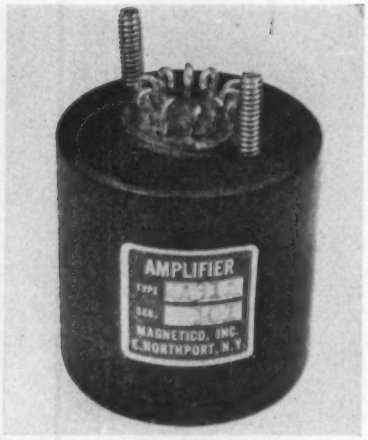
Damage, due to production line stoppage, has been practically eliminated because, in contrast to hot air equipment, infrared heat peaks and shuts off almost instantly.

This is only part of the story. Innumerable progressive manufacturers in such diverse industries as metalworking, wood, paper, textiles, food and many others are using Fostoria Infrared Ovens to bake, dry, cook, dehydrate, and perform other heat processing applications—in short to produce better products at lower cost. Case histories are available to you without charge. Write today, giving a brief description of your type of manufacturing and we'll send pertinent information as to how Infrared can benefit you.



FOSTORIA

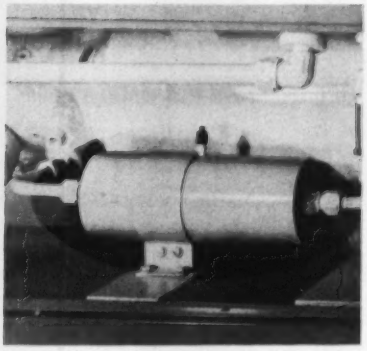
INFRARED DIVISION • FOSTORIA CORPORATION • FOSTORIA, OHIO



High Gain Amplifiers

Two low level high-gain amplifiers, Model-31 and Model-34, are designed for 60 and 400 cycle per second excitation respectively. These self-saturating full wave magnetic units can be used as linear or bistable amplifiers with dc or ac output. They are ideal for operating relays from low energy dc signal sources; particularly thermistor bridges, photo cells, null detectors, and similar devices. Operating ambient temperature is −55 to +100 C. The amplifiers have a maximum power output of 0.85 watts and a power gain in excess of 100,000. **Magnetico Inc.**, 6 Richter Court, East Northport, L. I., N. Y.

Circle 446 on Page 35



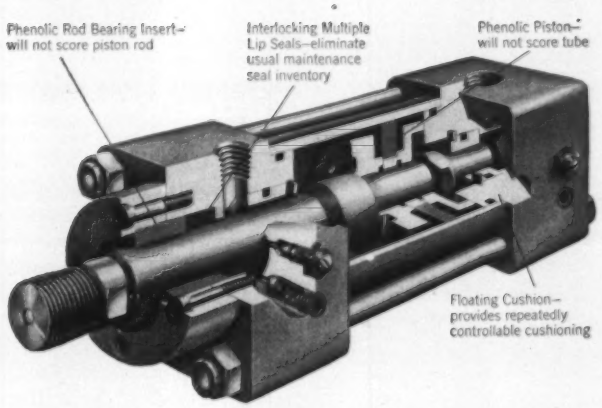
Ripple Filter

Pump pulsations are reduced to 1 per cent or less of system pressure by this high pressure ripple filter. The unit is a pump pulsation eliminator and noise trap for all classes of liquid pumps. It has no moving parts, contains no elastomer or flexible seals or members,

Fluid Circuitry News from Westinghouse

Industrial Product Division expands line

The Petch line of high quality air and hydraulic cylinders is now part of the line of Westinghouse Fluid Circuitry components. This acquisition makes it possible for us to offer industry the *most complete line* of air and hydraulic components for control systems to automate industrial production operations.


Phenolic Rod Bearing Insert–will not score piston rod
Interlocking Multiple Lip Seals–eliminate usual maintenance seal inventory
Phenolic Piston–will not score tube
Floating Cushion–provides repeatedly controllable cushioning

The Petch line of rugged, precision made cylinders include the following models:

Air & Low Pressure Hydraulic Cylinders

150 psi Air 500 psi Hydraulic
1″ to 10″ Bores
10 Standard Mountings

High Pressure Hydraulic Cylinders

1½″ to 6″ bores—2000 psi
8″ to 10″ bores—3000 psi
10 Standard Mountings

All Petch Cylinders conform to J. I. C. Standards.

FLUID CIRCUITRY... FOR TROUBLE-FREE AUTOMATION

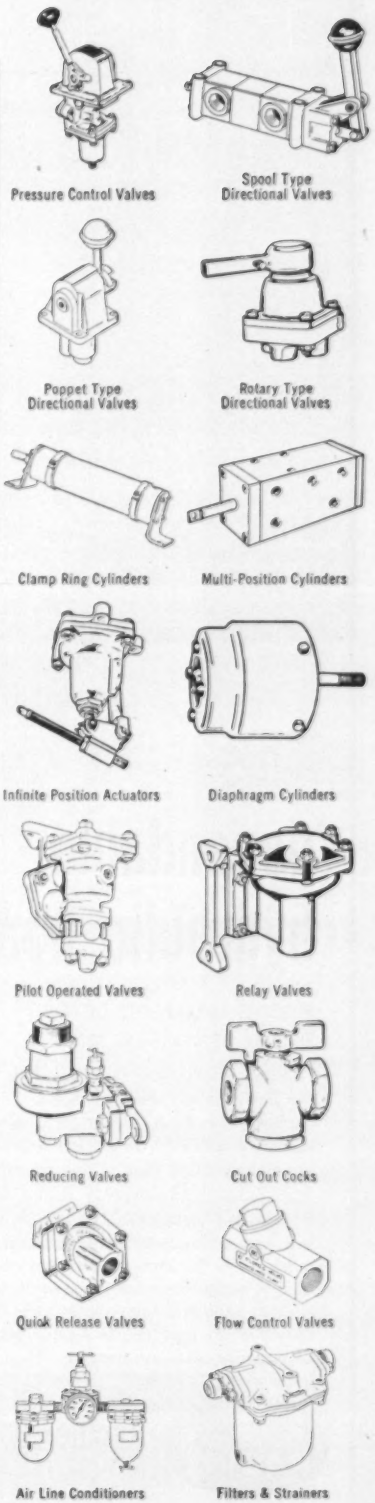
Fluid Circuitry is the application of fluid control systems to industrial production operations.

Fluid Circuits are economical, safe and precise. They are used to solve the most vigorous and complex control problems.

They contain reliable products to boost your production and cut your production costs.

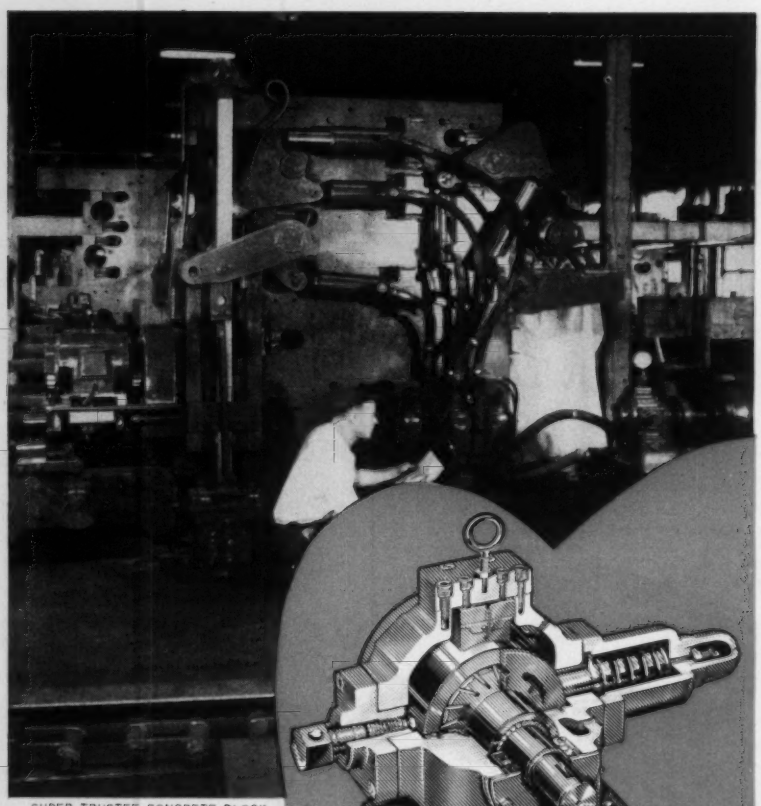
For more information on Petch Cylinders and Fluid Circuitry ask for catalog A3-56.00.

See the Yellow Pages under Cylinders for the Name of Your Local Distributor, or refer to Sweet's Catalog, Product Design File.



WESTINGHOUSE AIR BRAKE COMPANY
INDUSTRIAL PRODUCTS DIVISION, WILMERDING, PENNSYLVANIA

Circle 699 on Page 35



SUPER TRUSTEE CONCRETE BLOCK MACHINE BUILT BY THE GENE OLSEN CORP., ADRIAN, MICHIGAN

This dependable hydraulic heart

The heart of this 1100 blocks per hour concrete block machine is a
RACINE
MODEL 8R PUMP

REDUCES UPKEEP AND DOWN-TIME BY AS MUCH AS 80%

"RACINE HYDRAULIC EQUIPMENT is the *heart* of our concrete block machines," says C. S. DeLamater, sales manager for The Gene Olsen Corp., another satisfied user of RACINE PUMPS and VALVES exclusively since 1949. Besides the tremendous savings in operating hydraulically-designed concrete block machinery, the firm emphasizes the advantage of simplified control of oil circulation in RACINE VARIABLE VOLUME PUMPS. They pump *only* the oil required to do the job — no waste of pressure oil — no heating. Thus through lower horsepower, operation economies are enjoyed.

RACINE
Racine Hydraulics & Machinery, Inc.
RACINE, WISCONSIN
HYDRAULICS DIVISION

Circle 700 on Page 35

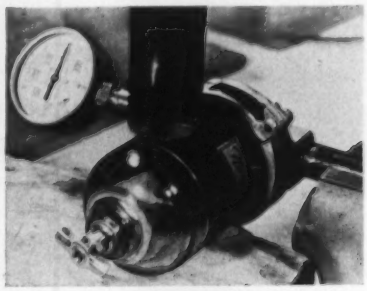
and is compatible with all liquids. Available in unlimited flow ranges, this filter is capable of handling working pressures up to 25,000 psi, and withstanding temperatures from −450 to +1000 F. **Auto-Control Laboratories Inc.**, 333 S. Hindry, Inglewood, Calif.

Circle 447 on Page 35

Elapsed Time Indicators

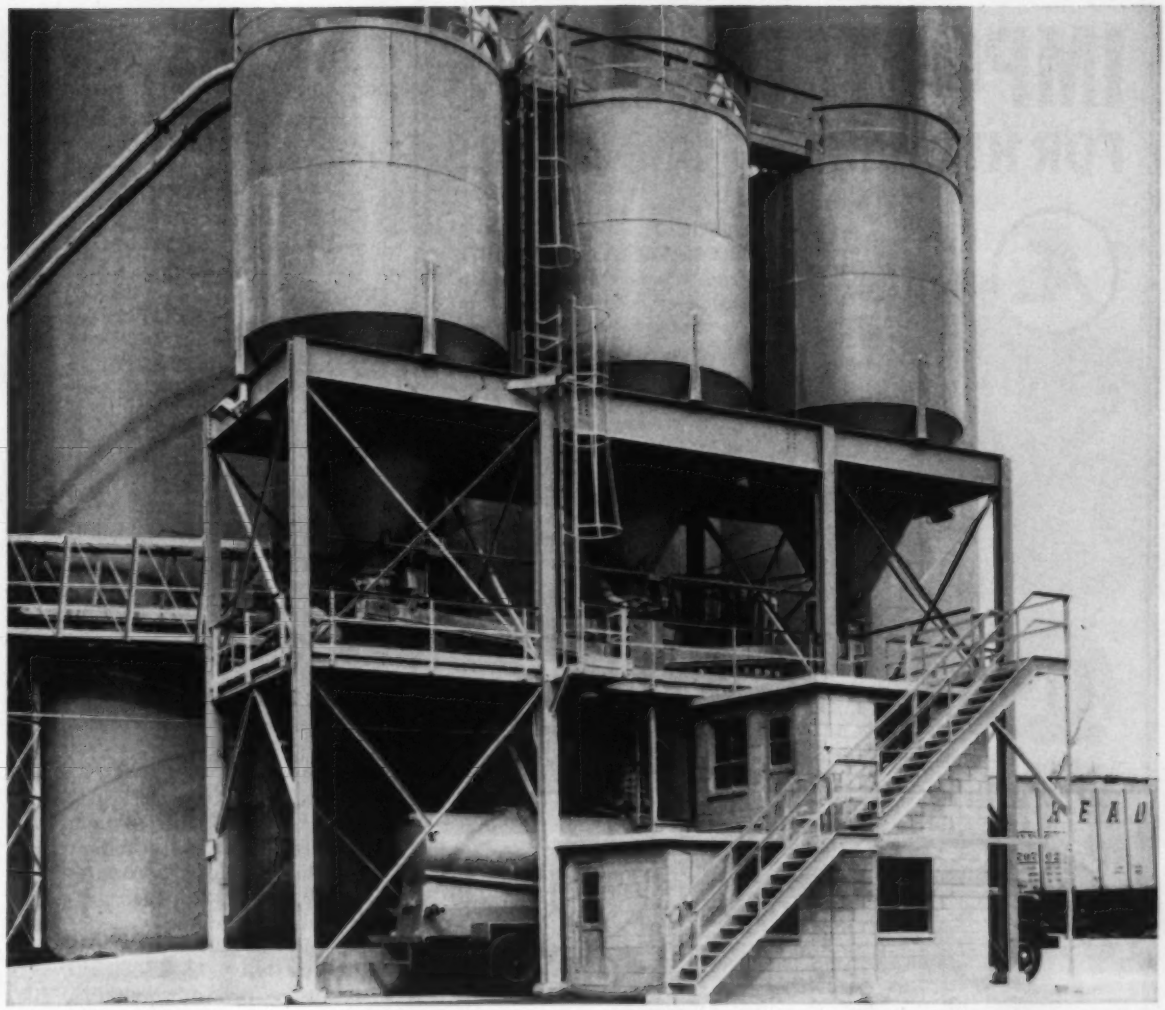
Running-time indicators, Series 5700, are applicable for time study and cost analysis, periodic maintenance, parts replacement, tool replacement, and preventive maintenance. They can be used in connection with computers, ovens, driers, photograph printers, recording instruments, grinders, induction heaters, and generators. Units have a range of 99,999.9 hours (minutes available on request) with a minimum time indication of 1/10 hour. They are rated at 115 v, 60 cycles; 230 v, 50 cycles; 230 v, 60 cycles; or 24 v, 60 cycles. **Automatic Timing & Controls Inc.**, King of Prussia, Pa.

Circle 448 on Page 35



Transparent Bowl

Unbreakable transparent bowl has been designed for use with a line of air line filters and lubricators. It is so tough that it will not break or shatter and offers superior



Why 9 Out of 10 New Bulk Loading Stations Use Airslide Conveyors

Fuller Airslide® Fluidizing Conveyors are the overwhelming choice for bulk truck-loading because dry pulverized materials, such as cement and barite, are bulk-loaded cleanly and efficiently in less than 5 minutes per truckload. One man can control the entire loading operation. Problem of dust is minimized since dust can be easily vented to dust collectors.

RIDES ON AIR

Dry material is moved over the inclined surface of the upper chamber of the two-chamber conveyor. Low pressure air is blown through the lower chamber, from which it passes upward through a layer of porous fabric. There is no need for moving parts, no noise, no lubrication. And fluid delivery by air means ease of control and fast shut-off when necessary.

LOW HP

Airslide Conveyor installations are characterized by their low horsepower consumption.

Airslide Conveyors are efficient and economical in operation too. Fuller engineers will gladly tell you more about how they can apply to *your* bulk loading needs. Write us at the address below. 2554 G-238

"See Chemical Engineering Catalog for further details and specifications."

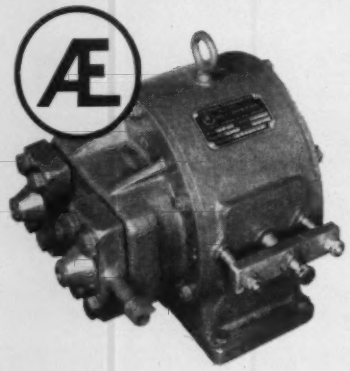
FULLER COMPANY GENERAL AMERICAN TRADE MARK

FULLER COMPANY
162 Bridge St., Catasauqua, Pa.
Subsidiary of General American Transportation Corporation
Offices in Principal Cities Throughout the World

Fuller
....pioneers in harnessing AIR

Circle 701 on Page 35

IMPORTANT NEWS
FOR HYDRAULIC PUMP USERS



AMERICAN ENGINEERING'S HELE-SHAW and **HYDRAMITE** pumps are now being precision engineered and fabricated at the Aircraft Armaments, Inc. plant at Cockeysville, Md.

Be assured that the same craftsmanship and high standards of quality which make **HELE-SHAW** and **HYDRAMITE** pumps leaders in their field will be maintained in the **IMMEDIATE CONTINUED PRODUCTION** of these pumps by Aircraft Armaments, Inc.

Please address inquiries to:

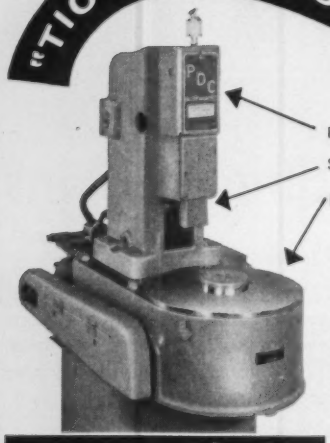
AE INDUSTRIAL DIVISION
AIRCRAFT ARMAMENTS, INC.
Post Office Box 6853, Baltimore 4, Maryland

CLEVELAND DISTRICT: A. E. Company, 1157 Leader Bldg., Cleveland 14, Ohio

NEW YORK DISTRICT: A E Industrial Division, 1 Exchange Place, Jersey City 2, N. J.

Circle 702 on Page 35

"TIC-TOCK AROUND THE CLOCK"...



PDC Air-operated Toggle Action Press Head Shown

Standard risers available to increase shut height

PDC-EMUC-15 Electric Drive Index Table

PDC "AUTOMATIC" DIAL ASSEMBLY PRESS ... Range to 6 Tons

A PROVEN FACT: the PDC Automatic Dial Assembly Press *increases* production and *lowers* costs, and has proven itself in production for many years. It can be either hand-fed or hopper-fed.

This Standard Dial Assembly Press is for operations such as

- **Assembling**
- **Staking**
- **Riveting**
- **Pressing**
- **Forming**

This machine can also be furnished with spinner heads, rivet hammers, punch presses and many other types.

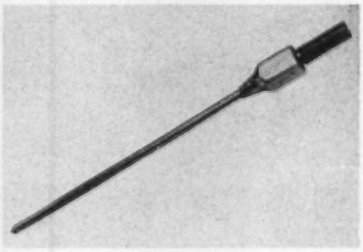
Write **TODAY** for new Catalog 60, for designers and engineers.

PRECISION DETROIT COMPANY
20100 SHERWOOD • DETROIT 34, MICHIGAN

Circle 703 on Page 35

resistance to solvents, oils, or corrosive gases. Because of its shatterproof qualities, this bowl completely eliminates the need for bowl guards or wire reinforcement, yet it is clearly transparent to permit visual inspection. Maximum operating conditions for the bowl are 250 psi at temperatures up to 200 F —200 psi at temperatures reaching 250 F. **C. A. Norgren Co.**, Englewood, Colo.

Circle 449 on Page 35



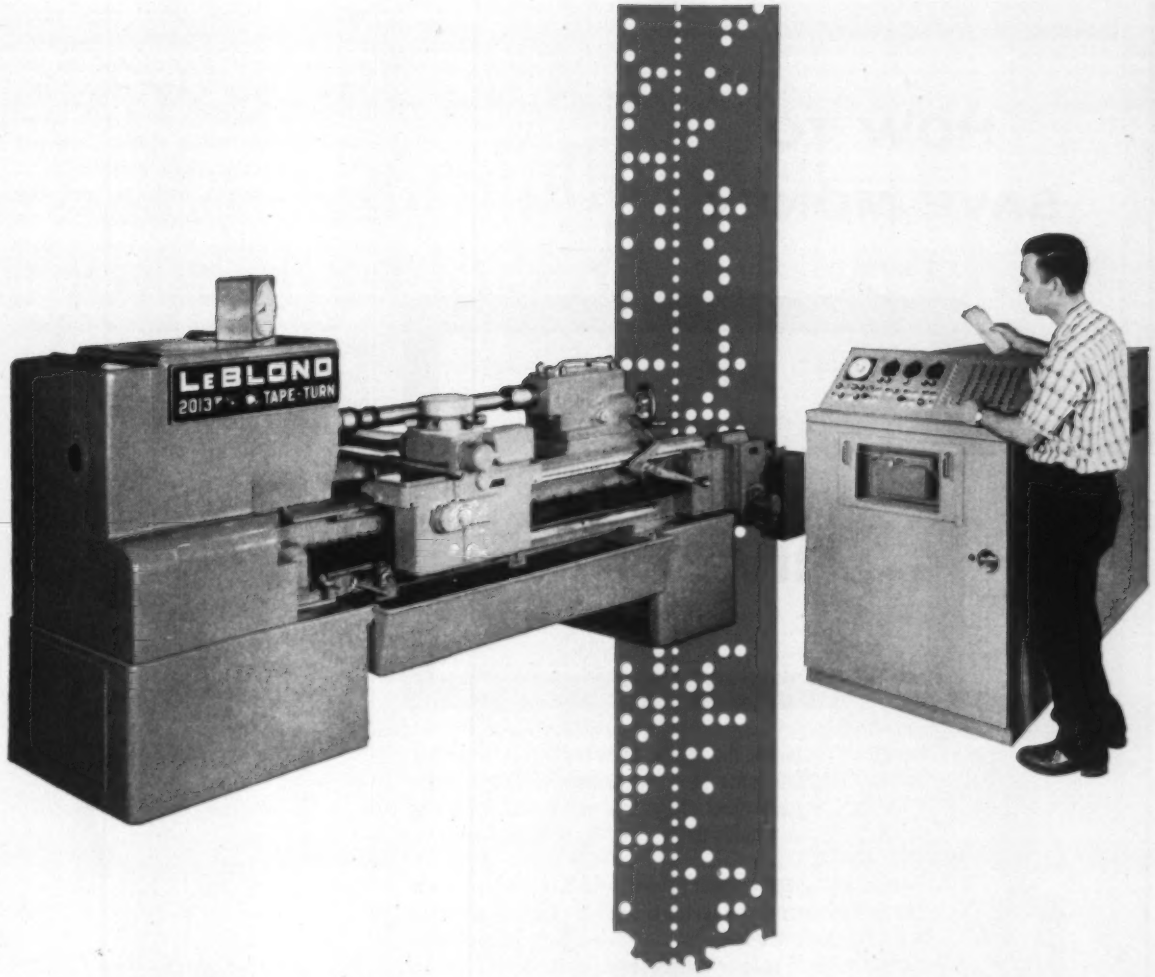
Tip Surface Thermocouple

Miniature thermocouple with a sensing tip extension of up to four inches makes possible high-response surface temperature measurements through thick container walls. It will operate under extremely high velocity and pressure conditions. Model E features a response time of less than 10 microseconds, a continuous service temperature of 2000 F, an operating pressure range to 25,000 psi, and a sensing tip with unlimited life. Thin ribbon thermocouple wires and mica insulation of 0.002 inch thickness are used. **Nanmac Corp.**, Dept. 41, P. O. Box 8, Indian Head, Md.

Circle 450 on Page 35

Manifold Valve

Differential pressure diaphragm controlled manifold valve is useable for vacuums down to 10^{-6}mm of



TURN WITH TAPE

Do it with TAPE TURN, the lathe that turns contours by numerical control; and tapers, sharp angles, radii, facing cuts and plunge cuts besides, not to mention heavy duty straight turning. No need for handwheels and levers. This lathe takes orders remotely from standard 1" 8-channel punched tape or a convenient pushbutton keyboard.

Tape-Turn puts engineering specifications at the cutting edge. Production Control can maintain control. Command by General Electric's new Mark Century numerical control. Full zero offset. Manual overrides at the console.

Turn contoured parts like this with tape and cut costs up to 75 per cent over tracer turning. Full range of spindle speeds and horsepower, all the beef you need for heavy production turning with LeBlond Tape-Turn models in several sizes. Write for documented savings with Tape-Turn, or ask your LeBlond representative for the Tape-Turn bulletin.

LEBLOND of Cincinnati

THE R. K. LEBLOND MACHINE TOOL CO. *World's Largest Builder of a Complete Line of Lathes* MADISON AT EDWARDS ROADS, CINCINNATI 8, OHIO

Circle 704 on Page 35

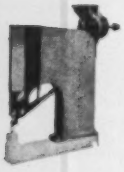
HOW TO SAVE MONEY BY RIVETING

Design for rivets. Use their adaptability not only for assembly, but for electrical contacts, pivots, inserts in molded materials, fastening a number of parts in one operation, joining metallic and nonmetallic parts together, or to each other.

Plan on **high speed assembly**. Riveting is a high speed operation, and even manually operated machines include automatic hoppers. The uniform quality and strength of Milford semi-tubular, tubular, split or compression rivets permits the use of high speed production equipment by unskilled operators.

Count on a **positive** joint. A riveted joint can be visually inspected, an advantage not to be overlooked when compared to many other methods of fastening.

Use Milford's "five plant" facilities. Each Milford plant is strategically located to serve the important industrial areas of the U.S. **Order** and **get** Milford Products **when** and **where** you need them.



Have **uninterrupted production** with Milford rivet-setting machines. Used singly, or in economical "multiples", where you set more than one rivet with no increase in labor or handling costs, Milford riveters, setting Milford rivets, are the surest way to lowest in-place assembly cost.

THE MILFORD RIVET

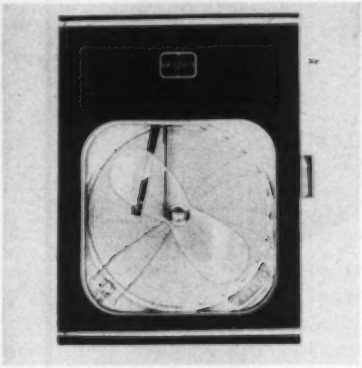
MILFORD RIVET & MACHINE CO.

MILFORD, CONNECTICUT • HATBORO, PENNSYLVANIA
ELYRIA, OHIO • AURORA, ILLINOIS • NORWALK, CALIF.

Circle 705 on Page 35

mercury. When tested on a mass spectrometer, it showed no apparent leakage at 10^{-10} standard cc per second. Valve is available for this service in stainless steel and brass. Used in automatic control circuits and compatible with gases such as oxygen, nitrogen, helium, etc., the valve has the additional feature of having only one moving part (the diaphragm). Parts are designed to take tube sizes from $\frac{1}{8}$ to $\frac{1}{2}$ inch in either flare or flareless fitting. Range of sizes is the same for pipe taps. **Frankel Engineering Laboratories Inc.**, 207 S. Fifth St., Reading, Pa.

Circle 451 on Page 35



Recorder-Controller

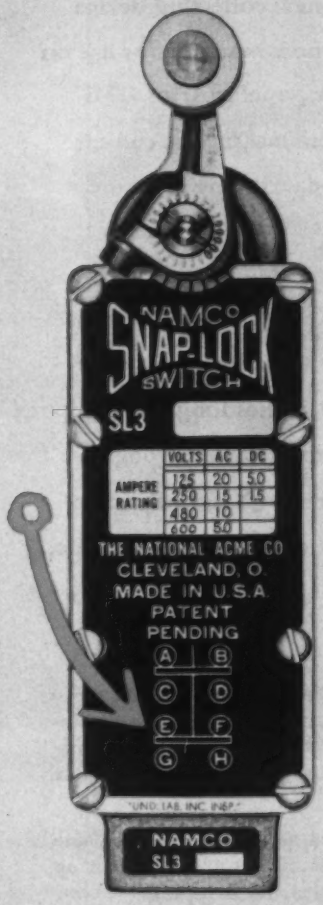
Time-program recorder-controller, Series 500, makes it possible to record repetitions of a program on a single chart. Program time may be from 30 minutes to 30 days. Various models of the instrument measure and control temperature, pressure (including absolute pressure), flow (mercury manometer or bellows-differential meter), liquid level, and humidity. Either pneumatic control or Free-Vane electronic control is available. Pneumatic control can be on-off or proportional or reset control. **Bristol Co.**, Waterbury 20, Conn.

Circle 452 on Page 35

Controlled Rectifiers

Miniature Thyrode silicon controlled rectifiers weigh as little as 1/10 of an oz and are 15/16 inch in length. They are capable of directly replacing mechanical relays

Take your pick... 1, 2 or 3 normally open, normally closed electrical circuits



What does your limit switching application call for . . . one, two or three normally open, normally closed electrical circuits? Whatever it is, one of these National Acme SL "Machine Life" Limit Switches . . . the SL2, the SL3 or the SL4 . . . will meet your precise requirement. And, every SL offers . . . a variety of cam arrangements for extreme operating flexibility . . . ample overtravel (67°) and by-pass (90°) . . . light operating pressure (10½ lbs. at 1½" radius). Also available . . . the SLS 2, 3 or 4 featuring "hi-shock" sliding contacts; particularly suitable for drop forge, punch press and other heavy equipment application. Call, write or wire for complete information.

National Acme

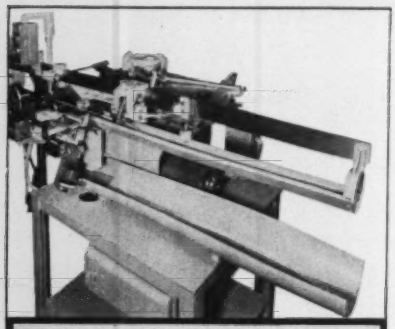
THE NATIONAL ACME COMPANY
196 E. 131st STREET
CLEVELAND 8, OHIO

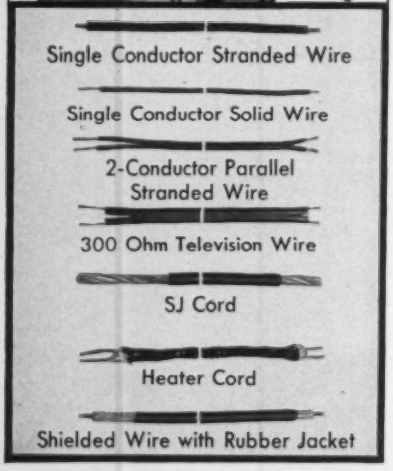
Sales Offices: Newark 2, N. J., Chicago 6, Ill., Detroit 27, Mich.

Circle 706 on Page 35

Another Time and Labor Saver

for finishing wire leads with ARTOS AUTOMATIC CS-6





A new collecting device is now available for use on the popular Artos CS-6 wire-measuring, cutting and stripping machine. Illustration shows the new collecting trough (AE-478). Upper trough collects wire leads up to 60 inches long, then empties into the lower trough after wire has been cut, thus saving operator time.

Production speeds of 3000 finished wire leads per hour up to 15 inches long. Maximum cutting length is 194 inches . . . stripping up to 2 inches at one or both ends. Artos also makes machines that measure, cut, strip and *attach terminals* automatically at one or both ends.

Operated by unskilled labor. Errors and work spoilage, due to human element, are eliminated. Machines are easily set up and adjusted for different lengths of wire and stripping.

Proved performance. Time-consuming hand stripping jobs which once were a bottleneck in many plants are gone forever. As a result, Artos automatic wire strippers are paying their way in the mass production of television and radio sets, electrical appliances, motor controls and instruments of all kinds.

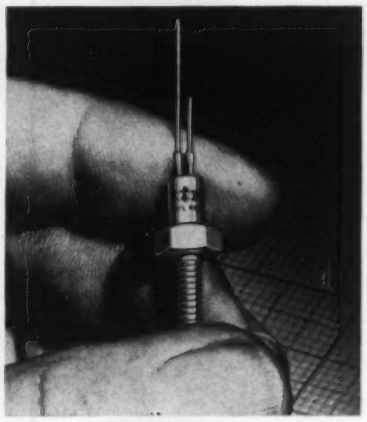
If you need big capacity on wire lead finishing, WRITE for descriptive Artos Bulletin No. 36. Engineering consultation without obligation.

AGENTS THROUGHOUT THE WORLD

World Leaders in Automatic Machines for Finishing Wire Leads

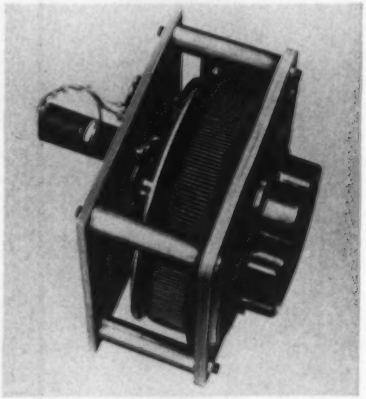
ARTOS ENGINEERING CO.

2785 South 28th Street • Milwaukee 46, Wisconsin



where load currents of 1 amp are required. Designated Types X1RC2 through X1RC20, the seven units have peak reverse voltage ratings of 20, 30, 50, 70, 100, 150, and 200 v. Low operating current range enables them to perform highly efficient power switching on such applications as computer circuitry, temperature control, servomechanisms, and ac and dc motor control. **International Rectifier Corp.**, 1521 E. Grand Ave., El Segundo, Calif.

Circle 453 on Page 35



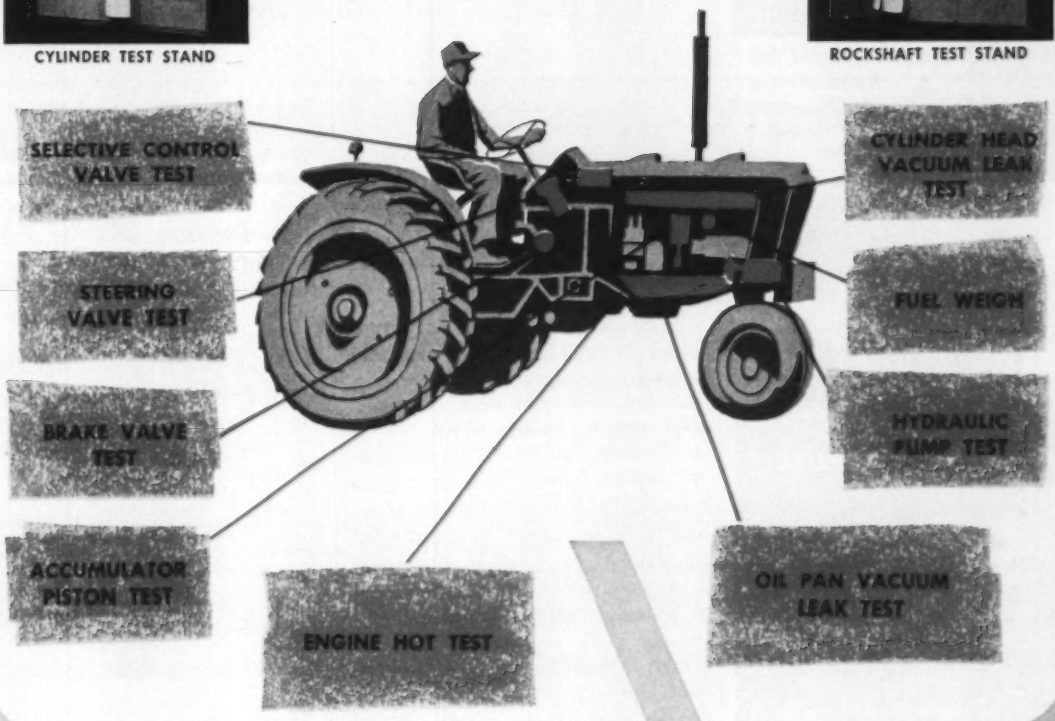
Motor Drive

Operating in conjunction with ADC Step-Servo controllers and pulse sources, Model A604A Step-Servo motor drive forms a new tool for autotransformer control independent of line frequency. It is designed to actuate General Radio Co. W20 (50-420 cps) or M20 (350-1200 cps) Variac to within 0.2 degree at rates to 110 increments per second. Drive units for other variable autotransformers are available. The time for full scale

Tested for QUALITY *by* CONTROL *Engineering Co.*

CYLINDER TEST STAND

ROCKSHAFT TEST STAND



Unified responsibility for *quality control* requirements

Any product can be made better by better testing. Control Engineering Company specializes in designing and manufacturing testing equipment . . . custom engineered to meet your specific requirements. The illustration above shows eleven important tractor parts that were tested for quality on Control Engineering test stands.

Applying new methods of testing the performability of your products will pay for themselves quickly because the field conditions under which this part must perform are duplicated in your plant. This method of inplant testing maintains top quality, provides dependable performance records and eliminates costly service and replacement.

There is hardly a manufacturing plant of any kind — including yours — where the right application of quality control methods and equipment won't produce savings many times the cost involved.

The field engineers of Control Engineering Company represent the most complete and versatile line of test equipment available through any one source, and have the real "know how" in today's modern methods of Quality Control.

CONTROL ENGINEERING COMPANY

A SUBSIDIARY OF JERVIS B. WEBB COMPANY

8007 Joy Road • Detroit 4, Michigan

Circle 708 on Page 35

SANDVIK
Steel Belt
CONVEYORS
have SPECIAL ABILITY
for automated
handling

Solid, flat band of cold rolled carbon steel—

RESISTS OIL, HEAT AND ABRASION

SIMPLIFIES LIVE BACKLOGGING AND AUTOMATIC DISCHARGE

EASILY FITTED WITH SIMPLE GUIDE AND DISCHARGE DEVICES

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IN CANADA: Sandvik Canadian Ltd., P. O. Dr 1335, Sta. "O", Montreal 9, P. Q.

Circle 709 on Page 35

travel, stepping increments, and the number of autotransformers to be actuated by a single drive unit can be varied. **Automation Development Corp.**, 11824 W. Jefferson Blvd., Culver City, Calif.

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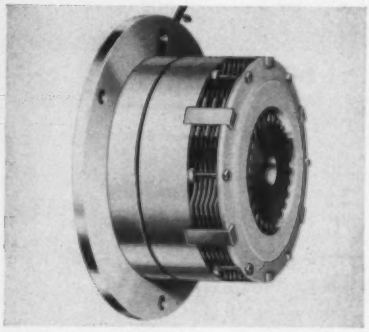
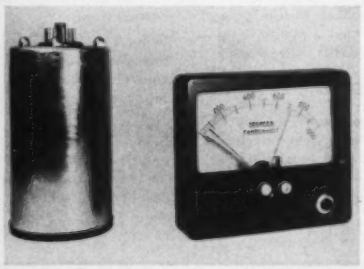


Magnetic Brake

Electromagnetic brake with a high torque versus size ratio is available in twelve standard sizes ranging in diameter from 2.25 to 11.5 inches, with torque ratings from 35 to 32,500 lb-in. Engagement is extremely fast, yet smooth and shock-free. Unit has good heat dissipation characteristics, and torque is not affected by speed of engagement. Brake has a nonmagnetic mounting flange. It is provided with both inside and outside pilot register. It may be flange or shaft-mounted for through-shaft or shaft-end use. The unit may be operated dry or in oil without alteration. **Fawick Airflex Div., Fawick Corp.**, 9919 Clinton Rd., Cleveland 11, Ohio.

Circle 455 on Page 35



Meter-Relays

Line of meter-relays and plug-in packaged controls combines instrument and relay functions. Sensitrol Model 1071 load current contact aiding type (shown) and Model 1072 magnetic contact type use plug-in control packages which may be plugged onto the back of the instrument or mounted remotely and connected to the instrument via cable. Both instrument and control package are provided with standard 11-pin octal plugs which can be mated with any commercially available socket. Features include 100-degree scales, lance pointers, sensitivity as low as 5 microamperes, indicator accuracy of ±1 per cent, and contact accuracy of ±4 per cent of full scale for lock-in. Both models measure 4.5 inches in front and 2.7-inch depth behind the panel. Control package for both is a steel case with cadmium plate and measures 2.75 inches. **Weston Instruments Div., Daystrom Inc.**, 614 Frelinghuysen Ave., Newark 12, N. J.

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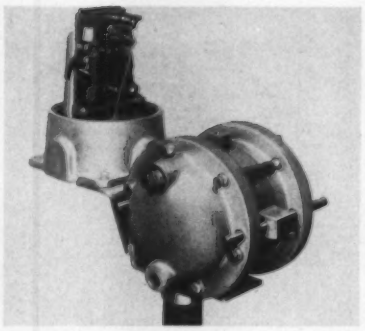
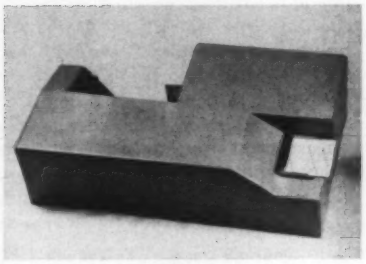


Flow Transmitter

Bellows actuated transmitter has been developed for pressure-operated, explosion-proof remote flow metering service in sewage and waste treatment plants or in pipe line distribution of gas or other hazardous materials. Differential pressure unit contains no mercury and is capable of withstanding working pressures up to 1000 psig. Units for higher pressures are available. Rupture-proof bellows can withstand pressures equal to the safe working pressures of the housing without deforming the bellows, causing loss of zero adjustment, or change in calibration. The flow transmitter and its receiver operate with equal transmission facility and flexibility over telephone or teletype lines, telegraph circuits, private signal lines, tone or microwave links. Standard time cy-

cle is 8 seconds; other cycles are available. Accuracy is ±1 per cent of span over a range of from 10 to 100 per cent of span. Mounting is by means of wall or floor flange. **B-I-F Industries**, 345 Harris Ave., Providence, R. I.

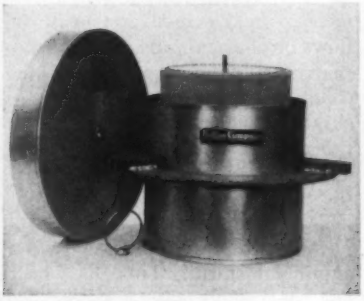
Circle 457 on Page 35



Card Reader

Compact serial tabulating card reader is available in two models which can be used for input or output for computer systems, for use in conjunction with accounting machines, for numerical controls of machine tools, and as a direct hookup with subsets for direct telephone line transmission of data. Features of the unit include ease of maintenance, flexibility of programming, and small 11 by 9 by 6 inch size. **Systronics**, 3673 Newton St., Torrance, Calif.

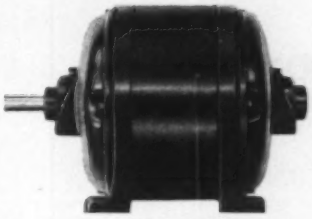
Circle 458 on Page 35



Air Filters

Portable air filters can be applied to a wide variety of vacuum-type pneumatic unloading systems. Originally designed for use in unloading cars involved with the bulk transport of polyethylene and polystyrene pellets, units can be used for filtering inlet or make-up air on any vacuum unloading system where

USE
MOTOR
LOAD



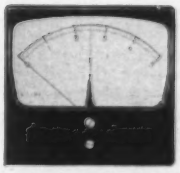
TO CONTROL
MACHINE OPERATIONS

Using motor load as the measured variable, API's Load Sentry is probably the most versatile—and perhaps the simplest—discrete machine control you're likely to find around. You can use it to switch from one feed rate to another, to measure actual accumulated work time or work count, to protect against mechanical or electrical overload from such causes as faulty work positioning, excessive torque, etc. All these conditions—and many more—are accurately reflected in motor-load current, a convenient means of control actuation.

Fast-acting Load Sentry will respond in less than 0.2 seconds to motor-load variations as little as 5% (in some cases 3%) of whatever norm you select. A simple index-pointer setting establishes the motor-load limit.

Built around the API contact meter-relay, Load Sentry is available as a simple contacting meter or a complete control package, ready to install. It has the inherent reliability of the locking-coil meter-relay: you can expect at least ten million operations without failure.

Load Sentry can be supplied to measure either amps or watts. It can be damped to limit response to steady overloads of up to three seconds' duration, and can include provision for start-up time delay. Bulletin 106-C will give you more detailed information.



api ASSEMBLY PRODUCTS, INC.
CHESTERLAND 27, OHIO

Circle 710 on Page 35

sanitation or prevention of product contamination is important. Intake filter is designed to filter air taken into a conveying system and a hatch filter (illustrated), is designed to filter air being drawn into a bulk carrier during unloading. The intake filter is designed to attach directly to the car unloading nozzle by means of a slip coupling, while the car vent filter is placed directly on the open car hatch. **Fuller Co.**, Catasauqua, Pa.

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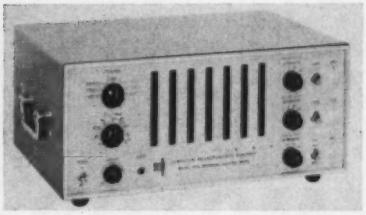


Counter-Timer

All transistor Universal counter-timer, designated Model 728A, combines functions of a counter, timer interval meter, and frequency/period meter. It performs seven basic functions selectable by a front panel switch. Unit is available with either standard vertical decade number panels or in-line Nixie readout. Output information will operate digital printers, punches, in-line readouts, and other data processing equipment. Measurement ranges for the counter-timer are dc to 20 mc for frequency; 0.1 microsecond to 10^7 for time interval; 0.1 microsecond for period. Accuracy is ±1 count ± oscillator stability. Sensitivity is 0.25 v rms; input impedance is 25k ohms per v. **Computer-Measurements Co.**, 12970 Bradley Ave., Sylmar, Calif.

Circle 460 on Page 35

QUICK
FLUID LINE
CONNECTION
or
DISCONNECTION

with
INSTANT
AUTOMATIC FLOW
or
SHUT-OFF

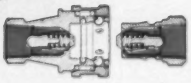
HANSEN
SERIES HK® QUICK-CONNECTIVE
TWO-WAY SHUT-OFF
COUPLINGS

Hydraulic and pneumatic lines are quickly and easily connected with Hansen Two-Way Shut-Off Couplings. No tools required.

When coupling is disconnected, valves contact valve seats in both Socket and Plug to provide instant and positive seal of fluid in both ends of line. Coupling does not depend upon line pressure to seal either end of line.

Hansen Series HK Couplings are furnished in steel or brass, with female pipe thread connections from ⅛" to 1½" respectively. Sizes up to 1" are also now available in stainless steel.

Representatives in Principal Cities ... See Yellow Pages

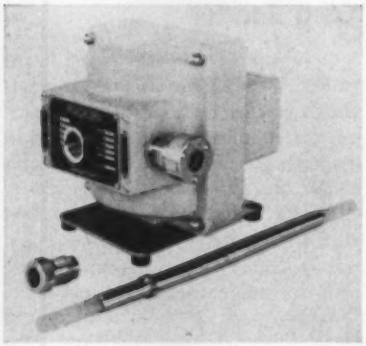


Instantly shuts off both sides of line... prevents loss of liquid, gas or pressure.

Quick-Connective Fluid Line Couplings for
COMPRESSED AIR • OIL
GREASE • HYDRAULIC FLUIDS
WATER • VACUUM • STEAM
OXYGEN • ACETYLENE
REFRIGERANTS • GASOLINE
COOLANTS • LP-GAS

Write for the Hansen Catalog
Here is an always ready reference when you want information on couplings in a hurry. Lists complete range of sizes and types of Hansen One-Way Shut-Off, Two-Way Shut-Off, and Straight-Through Couplings.

SINCE 1915 QUICK-CONNECTIVE FLUID LINE COUPLINGS
THE HANSEN MANUFACTURING COMPANY
4031 WEST 150th STREET • CLEVELAND 35, OHIO



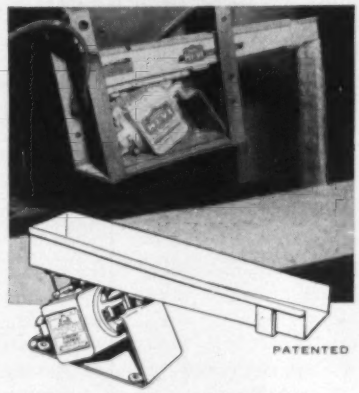
Flow Meter

Featuring a removable flow tube for convenient sterilization, flow meter can be used in measuring flows of pharmaceuticals, film emulsions, food ingredients and other conductive materials requiring accurate sanitary measurement. Flow tube of the transmitter has tapered and serrated ends to receive 3/16, ¼, ⅜, or ½-inch ID flexible tubing and is made of inert nonwettable plastic with Type 316 stainless steel alignment sheath. Tube and stainless steel electrodes are the only meter parts in contact with flow. Easily removed, the flow tube is suitable for repeated steam autoclaving at 250 F and 15 psig for ½-hour or sterilization by gas or germicide. Metering accuracy is ±1 per cent of full scale throughout entire scale; repeatability is within ±0.5 per cent; flow range, 0-1 liter per minute or higher. **Foxboro Co.**, Foxboro, Mass.

Circle 461 on Page 35

ERIEZ *Magnetic Minute*

60 seconds that will help you improve operating efficiency.



FEED MOST ANYTHING, FROM OUNCES TO MANY TONS PER HOUR

There's an Eriez Vibratory Feeder to handle anything from powders to parts, rivets to rocks!

Versatile, AC operated Hi-Vi® Feeders, with 100% range of control, provide accurate, economical performance whether you're feeding a few ounces or many tons per hour. They're ideal for many feeding operations including spreading, sorting, aerating, cooling, drying, sifting, separating, proportioning, formulating, mixing, coating, and dusting.

Only Eriez gives you this exclusive combination of advantages: No rectifier needed (AC operation) . . . Totally enclosed drive element is ideal for hazardous, dusty, wet, or corrosive conditions . . . New fibre glass springs assure superior performance and control, longer life because spring breakage is practically eliminated.

Choose from many models for light, medium, or heavy duty applications.

For big new catalog, write to:

ERIEZ MANUFACTURING CO.
119RA Magnet Drive, Erie, Pa.

MAGNA-THOUGHT

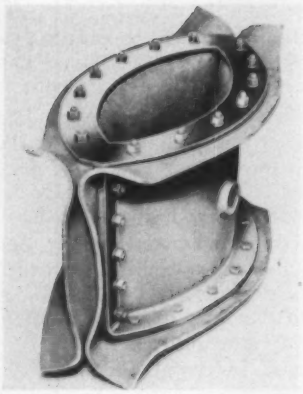
The selection of any piece of equipment should be based on its ability to perform effectively on the job.

R. J. TORREY
Manager
Research & Development

ERIEZ

A GROWTH COMPANY . . .
10 NEW PRODUCTS IN THE LAST 5 YEARS

Circle 712 on Page 35



Discharge Valve

Rubber diaphragm peristaltic type discharge valve makes it possible to handle coarse abrasives such as catalysts, pellets, and other odd shaped materials unable to pass through conventional rotary valves. The valve's elliptical body and sandwiching of its sheet rubber diaphragms insure positive closure. Movement is confined to the valve's gum rubber diaphragms which alternately open and close by air pressure or vacuum. This action permits discharge of materials in measured quantities with 100 per cent air tight seal. Unit features fail-safe operation. **Air Appliance Div., U. S. Hoffman Machinery Corp.**, Dept. EJM, 103 Fourth Ave., New York 3, N. Y.

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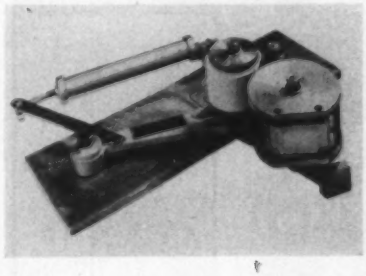
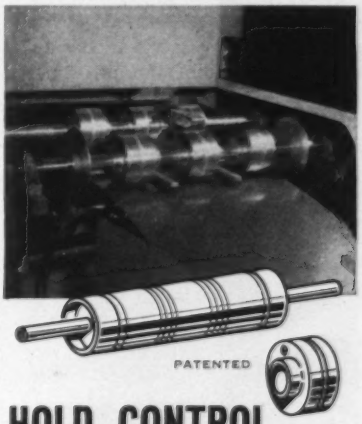


Carton Coder

Front and side coder features a pneumatic control which regulates the forward and reverse movement of the marker. The control, a pneumatic check and spring, prevents the printing head from vibrating as it moves forward and back. It also maintains the constant pressure that is needed between the marker and carton face during the printing cycle. Designed for use as an attach-

ERIEZ *Magnetic Minute*

60 seconds that will help you improve operating efficiency.



HOLD, CONTROL, ELEVATE, CARRY

ferrous materials magnetically

Do it with MAGNA-ROLLS — from the Eriez line of Magnamation® (permanent magnetic automation) components. They're particularly valuable in speeding and simplifying sheet handling.

Use Magna-Rolls as magnetic head pulleys to carry ferrous materials up and over or down and under belt conveyor lines. Use them singly or in multiples for feeding, conveying and controlling parts on non-belt systems. As magnetic feeders to control and feed sheets, blanks and formed parts to various operations, and many other ways too!

Magna-Rolls can be furnished in diameters ranging from 2½" to 30". Erium® powered magnetic strengths and field depths can be furnished to meet specific requirements. In the wide range of standard and modified standard units you will almost certainly find a simple, economical solution to your specific handling or conveying problems.

Full data on Eriez Magnamation components is available in our newest Bulletin. Write for it to:

ERIEZ MANUFACTURING CO.
119RB Magnet Drive, Erie, Pa.

MAGNA-THOUGHT

Most of the very first installations of Eriez equipment are performing as effectively today as they did when they were new, years ago.

A. F. ISRAELSON
Chief Engineer

ERIEZ

A GROWTH COMPANY . . .
10 NEW PRODUCTS IN THE LAST 5 YEARS

Circle 713 on Page 35

ment to a compression sealer, the coder marks the front and side of filled cartons in one cycle. It is capable of marking, without slow-downs, conveyor-carried cartons spaced approximately 6 inches apart and printing the imprint, starting about 4½ inches from the carton's edge. The unit has a self-contained ink reservoir which feeds the printing head through a felt roller. **Industrial Marking Equipment Co. Inc.**, 655 Berriman St., Brooklyn 8, N. Y.

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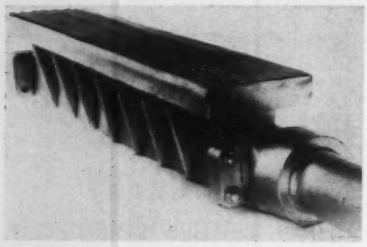

Infrared Burner

Gas-fired infrared burner with controlled wavelength radiant emission for high-efficiency heat transfer is designed specifically for low-temperature industrial processing applications. Face temperature of the burner screen is 1200 to 1800 F. Nominal heat output is 30,000 Btu per hour per unit; each unit has a built-in flame adjustment. Applications for the burner include drying metals, curing shell molds and foundry cores, drying moist fabrics, and paint and enamel baking. Burner lights end-to-end full length from a single pilot, and will also light from one line to an adjacent one when assembled in solid banks. **Bryant Industrial Products Corp.**, 17700 Miles Ave., Cleveland 28, Ohio.

Circle 464 on Page 35

Digital Arithmetic Center

Now available as an off-the-shelf unit, Model DAC-2500 digital arithmetic center is a solid state component for computing process control, instrumentation, and test systems. It is compatible with all varieties of input and output units and systems concepts. Flexible input and output control circuits allow a full range of peripheral equipment to be easily connected with the center. These include punched card and punched tape units, analog-to-digital converters, digital voltmeters, X-Y plotters and printers. Specifications: Number system, decimal; word length, 18 decimal digits and sign; storage, magnetic drum; storage capacity; 16 words per channel —nonvolatile, with 10 channels available and 2 channels supplied as standard equipment. Access time, average 8.5 milliseconds; instructions, multiple address (up to 5) and multiple operations; input of data, unique pulse per digit or binary coded decimal; input of instructions, dc voltage to proper connector pin or pins; output, pulse per digit or binary coded decimal. **Clary Corp.**, 408 Junipero St., San Gabriel, Calif.

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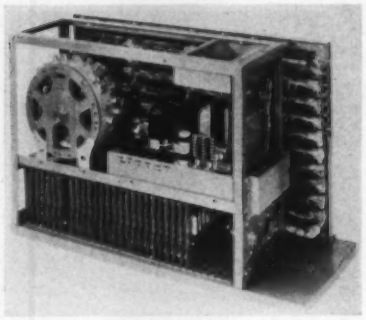

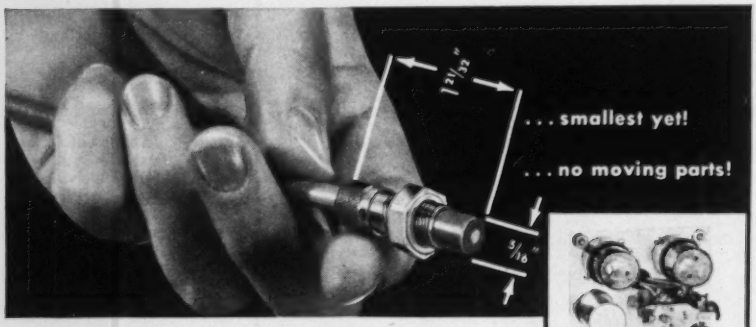

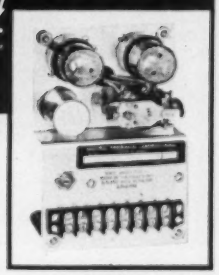

LOWEST PRICE...SMALLEST

Proximity Switch

OBTAINABLE!

Actuated by NON-MAGNETIC and MAGNETIC metals to solve electrical switching problems

Now Electro offers you a low cost proximity switch incorporating the basic *patented* circuit used successfully in industrial plants for more than 5 years.

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users net includes:

Control amplifier 4902
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ELECTRO PRODUCTS LABORATORIES, 4501-A Ravenswood, Chicago 40

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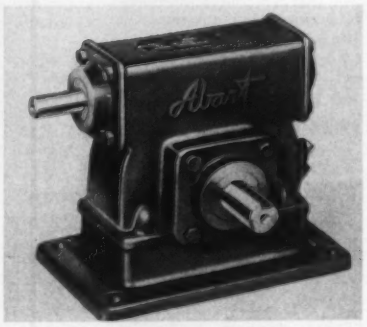
Most complete line of Proximity Switches and Magnetic Transducers · Tachometers · DC Power Supplies



Speed Reducer

Right angle drive, horizontal worm gear speed reduction unit is built for continuous duty in stokers, conveyors, agitators, and spraying equipment. It provides speed ratios from 5 4/5:1 up to 100:1, handling inputs of ¼ to 2 hp at 1800 rmp and 1/6 to 1½ hp at 1200 rpm. Model 2 ⅝A is made with a case hardened and ground alloy steel

worm integral with its shaft. It can be furnished with input or output shafts projecting from either side of the housing, or from both sides. **Abart Gear & Machine Co.**, Dept. AN-5, 4834-36 W. 16th St , Chicago 50, Ill.

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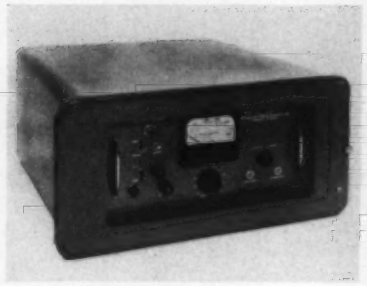

Metal Detector

Instrument locates small ferrous or nonferrous tramp-metal particles in nonmetallic materials. It is particularly adapted to finding metal of any kind in products which are handled on a conveyor belt or continuous process line. Model 200A is intended for use with conveyor belts as wide as three feet. Other coil-system configurations are also available. Ferrous particles whose smallest dimension is 0.063 inch and nonferrous particles whose smallest dimension is 0.085 inch can be detected at conveyor speeds between 1 and 100 feet per minute. **Electro-Mechanical Research Inc.**, P. O. Box 3041, Sarasota, Fla.

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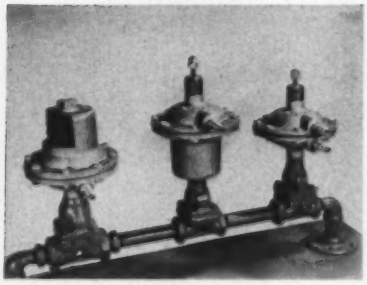
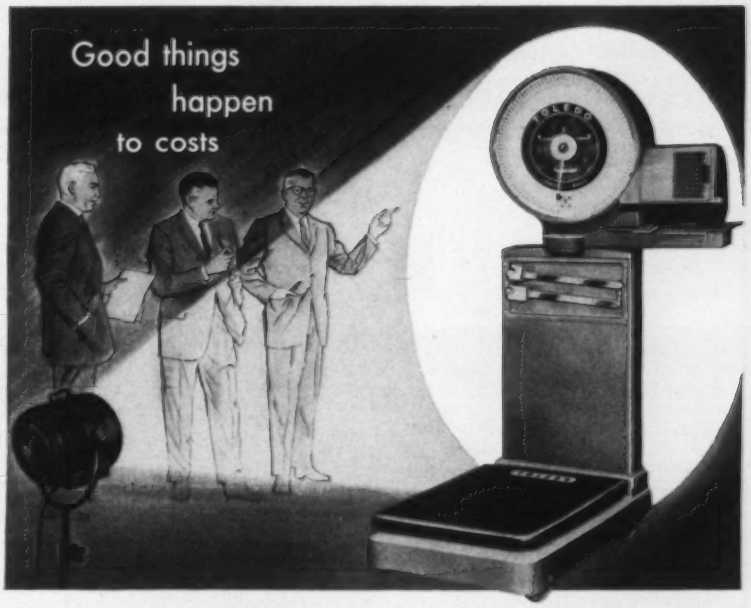


Diaphragm Operators

Line of air-powered diaphragm operators is designed for remote actuation of diaphragm valves. Three types of operators are offered: Air-



...When Management Puts The Spotlight on WEIGHING

PRINTWEIGH® RECORDS: a Major Cost Control Tool

Materials become money . . . on your scales. Weight records directly affect costs, quality control, inventories and customer billing. That's why it pays to put the spotlight on weighing . . . and make sure you have the right TOLEDO scale at every weighing point.

A close look at weighing is especially called for if you've made changes in plant layout, materials handling methods, or inventory controls. In any of these areas, scales that don't fit the job can bottleneck operations, infect weight records with costly errors.

Complete Printed Weight Records with TOLEDO PRINTWEIGH "400"

Prints complete weight records on tickets, sheets or strips. Transmits weight data to remote locations where it is recorded by office machines, if desired. Ask for Bulletin 2017.

We'll be glad to help you evaluate weighing efficiency in your operations. A few minutes at each weighing station will put the spotlight on scale capacity and location, dial visibility, platform size and height and other important factors. Send for Bulletin 2036. TOLEDO SCALE, Division of Toledo Scale Corporation, Toledo 12, Ohio.

(Toledo Scale Co. of Canada Ltd., Windsor, Ont.)

SERVICE Factory-Trained Just Clicks

TOLEDO®

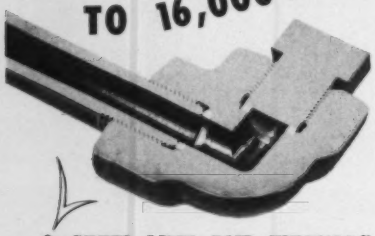
Headquarters for Weighing Systems

Circle 715 on Page 35

COMPONENTRY BY

CARDAIR

PRESSURES TO 16,000 PSI



° STEEL LINE AND FITTINGS

⅝" Diameter Flow Passage

Leak-proof Fitting Seal

Balanced Line Valves

Low Torque at 12,000 PSI

Replaceable Seats and Spindles

Control Valves

Pilot Operated Valves

Pressure Vessels

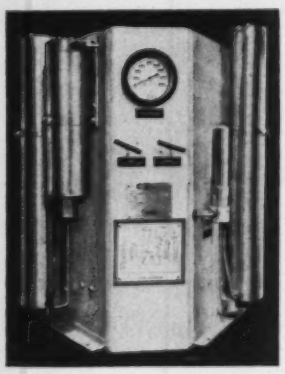
° DEHYDRATION EQUIPMENT

Cartridge Type Systems

Refrigerated Mechanical Separators

Oil Vapor Removal to 0.3 PPM

Minus 115°F. Dew Points



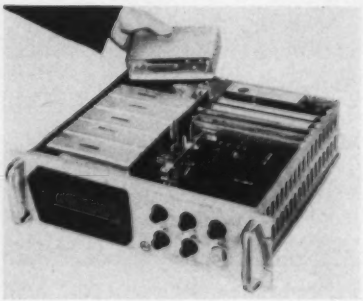
° *Write for Catalog Today!*

PRESSURE COMPONENTS, Inc.
3429-D OCEAN VIEW BLVD.
GLENDALE 8, CALIFORNIA

Circle 716 on Page 35

open, air-close; air-open, spring-close; and air-close, spring-open. Each is built in four sizes for ½ and ¾ inch, 1 and 1¼ inch, and 1½ and 2 inch valves. Other types of operators are available for valve sizes through 14 inches. The spring-loaded operators return the valves to full-open or full-closed position in event of air system failure. For throttling service an optional positioner with indicator is provided. Design features of the units include ability to actuate diaphragm valves at line pressures up to 150 psi; small physical size, and interchangeability of parts. **Hills-McCanna Co.**, 4600 W. Touhy Ave., Chicago 46, Ill.

Circle 468 on Page 35



Voltmeters-Ratiometers

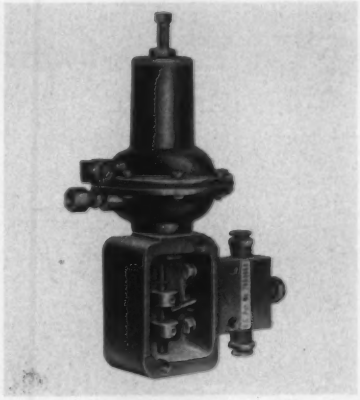
Series 30 digital voltmeters-ratiometers, four-digit V34A and five-digit V35A, feature a more versatile print control to permit printing of varying input signals, isolation of signal ground from chassis ground for signals which are floating up to 300 v above chassis ground potential, remote ac/dc switchover, increased input impedance in ratio measurements, and front-and-rear input connections. Both models utilize no-needless-nines logic that eliminates the cycling of stepping switches through all positions in each decade when a measurement is made. Model V35A features the factual fifth that permits full five-digit resolution of 0.001 per cent, even if the input signal is varying. These instruments measure dc voltage from ±100 microvolts to ±1000 volts, and dc voltage ratio from ±0.01 per cent to ±99.999 per cent. Accuracy is ±0.01 per cent on dc v and ±0.01 per cent to ±0.005 per cent on voltage ratio. Both units with accessories measure ac voltage and low level dc. They also have output for automatic data logging. **Non-Linear Systems Inc.**, Del Mar, Calif.

Circle 469 on Page 35

Variable Speed Pumps

To accommodate variations in flow consumption, these double suction centrifugal pumps by means of a speed control maintain constant boost line pressure while keeping it at a constant value. Key to the Rectiflow drive's automatic action is the use of a wound rotor motor equipped with rectifiers instead of resistors for speed control. Resulting dc current feeds into a dc motor which supplements the shaft torque. Discharge outputs of these pumps is set at a constant value, and suction pressures are allowed to vary. **Morris Machine Works**, Baldwinsville, N. Y.

Circle 470 on Page 35

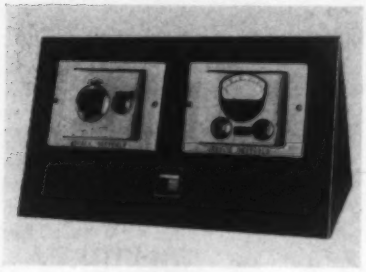


Pressure Switches

Diaphragm operated, adjustable pressure switches, designated Snap-O-Trol, have standard pressure ranges of 6 to 15 psi and are also available with ranges of 15 to 25

psi. Model CADM (shown) is equipped with a three-way snap-action valve, ideal for pneumatic control systems. Model CADMEX is equipped with a S.P.D.T. explosion-proof limit switch providing dependable, safe operation for systems requiring electrical control. **Instruments Inc.**, P. O. Box 556, Tulsa, Okla.

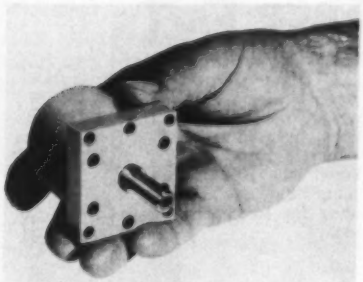
Circle 471 on Page 35



Load Controller

Optimum load controller is a means of maintaining a preset load on the drive motor of process equipment, machine tools, or web handling machinery. It can be used to obtain maximum production from a crusher, saw, grinder, hammermill, or pelletizer. It may also be used to preset web tension in a press, converter, or winder. The Loadtrol controller has all solid state components. It is designed for rough treatment and can be furnished in an explosionproof enclosure. Motors from fractional to several hundred hp may be controlled. **Jordan Controls Inc.**, 3235 W. Hampton Ave., Milwaukee 9, Wis.

Circle 472 on Page 35



Torque Actuator

Midget model Rotac torque actuator is being applied in instruments, computers, calculating ma-

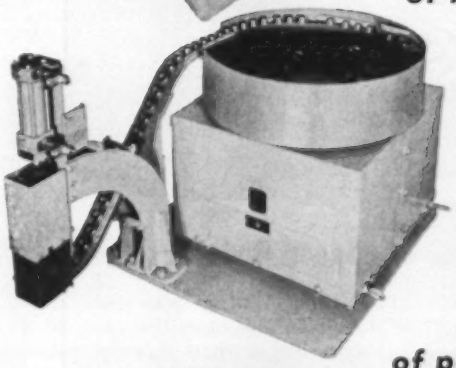
THE CARE AND FEEDING

of parts discharged at high or low heights

DPS ELEVATING FEEDERS elevate, orient and feed parts of almost any size, shape and material to other machinery for processing and assembly. High capacity storage bins are designed to assure a steady flow of parts to elevating mechanism regardless of load level.

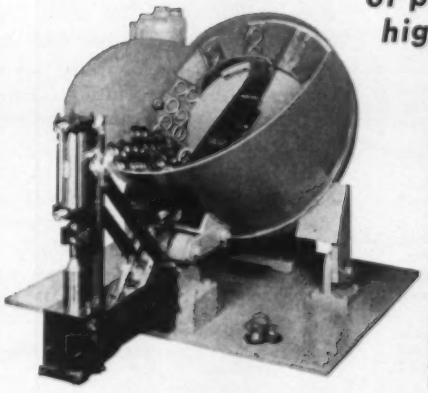
Orientation of parts is accomplished at discharge point of elevator — simplifying external track construction. Feeder can be arranged for right- or left-hand discharge. Return chutes are cushioned.

New Bulletin 2812 has full data on DPS elevating feeders. Write for your copy today.



of fragile or finished parts

DPS VIBRATORY FEEDERS are bowl type units that gently handle parts too light or fragile to be handled in rotary type feeders. Through a simple electromagnetic drive, a vibrating action is transmitted to the bowl causing the parts to move up a circular, inclined track. The oriented parts then enter feed tube or discharge track to machining or assembly areas.



of parts for high-production assembly

DPS ROTARY FEEDERS employ radially slotted or grooved rotating collector rings. Efficient orienting and feeding of parts is achieved through proper design and engineering of baffle plate, selector guard, feed track, and escapement mechanism. Three different designs are available to meet holding, orienting and feeding requirements. Safety clutch prevents damage to motor or gears in the event of parts jamming.

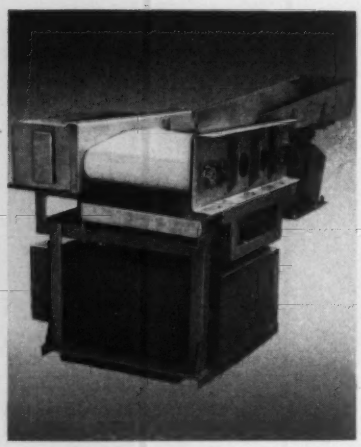
Detroit Power Screwdriver Company offers industry's most complete line of selective feeders . . . ranging in holding area from 80 cu. in. to 20 cu. ft. For complete details, call your DPS representative or write direct. *Ask for free catalogs!* 15,335

DETROIT POWER SCREWDRIVER COMPANY

2811 W. Fort St. • Detroit 16, Michigan

A Subsidiary of Link-Belt Company

Circle 717 on Page 35



CUT *PROCESSING* COSTS

Automatic Thayer Scale Controls 3 Ingredients in Cranberry Sauce Processing, Cuts Handling Costs and Increases Profits.

Costly, time consuming measuring, feeding and blending operations in the making of cranberry sauce have been mechanized with 1 Thayer Scale. Now a Thayer Metering Scale continuously feeds cranberries, at precise rates, to the cooking process. In addition, the scale automatically controls the 2 other ingredients required, resulting in better product quality and uniformity at lower handling costs.

Unlike conventional scales, the Thayer Scale has no knife edge pivots to wear and cause inaccurate weighing. The Flexure-Plate suspension system of the Thayer Scale cannot wear, requires no maintenance, and accuracy is guaranteed for millions of weighings.

Thayer engineers will inspect your product and production process and demonstrate how your costs can be reduced by more accurate weight control.

Write for information on BAGGING, BATCHING, METERING and CHECKWEIGHING SCALES.

THE *Thayer* SCALE

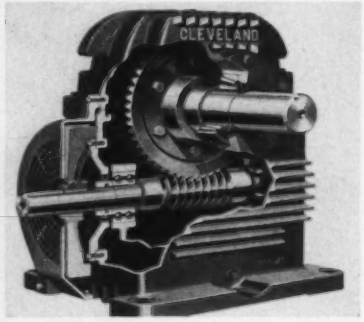
THAYER SCALE CORP.

3 Thayer Park
Pembroke, Massachusetts
TAylor 6-2371
A Subsidiary of Sundstrand Corporation

Circle 718 on Page 35

chines, switches, chemical controls, carton construction machines, remote control of valves, and many other light applications. Having a body only two inches square and two inches long, this unit is operated by hydraulic or pneumatic pressure to produce reciprocating rotary movement. Single-vane model produces rotation in a maximum arc of 270 degrees, while movement of the double-vane model is restricted to 90 degrees but power is more than doubled. **Ex-Cell-O Corp.**, Greenville Plant, 945 E. Sater St., Greenville, Ohio.

Circle 473 on Page 35



Speed Reducers

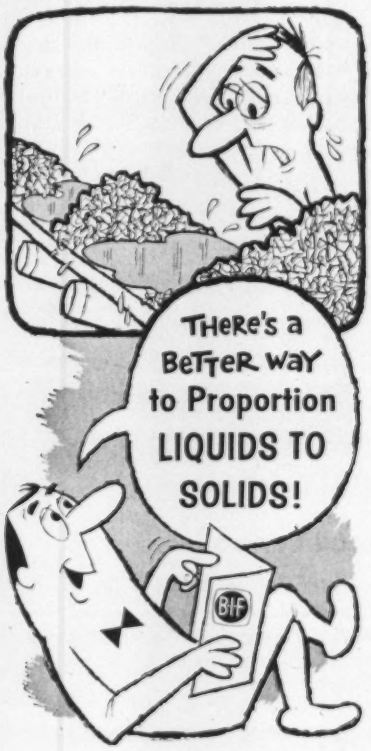
Line of worm gear speed reducers offers hp capacities up to 80 per cent higher than those of conventional reducers of the same type. Space savings of 50 per cent and more are possible between two reducers of the same rating. Line is available in 9 sizes ranging between 3-inch and 12-inch center distances. Ratios extend from 4-1/7:1 to 95:1, ratings from fractional to 175 hp. Reducers feature specially constructed radial fans which are equally effective in either direction of rotation. **Eaton Mfg. Co.**, 3300 E. 80th St., Cleveland 4, Ohio.

Circle 474 on Page 35

Electronic Counter

Count-Pak Series A-180606 is a complete unit designed for industrial applications where high speed photoelectric counting is desired, where actuating devices are electronic, or where pulse lengths are too short to actuate magnetic counters. It is now available with a special Senti-

B·I·F POSITIVE CONTROL OF MATERIALS FLOW



Does your present proportioning system suffer from short range limitations? Can one unit run empty and waste ingredients . . . spoil end product? B-I-F offers a new concept in the control of liquid to solid proportioning in the combination of its continuous dry materials weigher and its closed loop metering system. Fail-safe system — automatically stops when either unit is empty . . . prevents ingredient waste and product spoilage. Forced balance weighing principle provides wide range, greater accuracy. System governed by simple gravity flow . . . operates automatically, continuously . . . features explosion-proof construction!

Free Facts

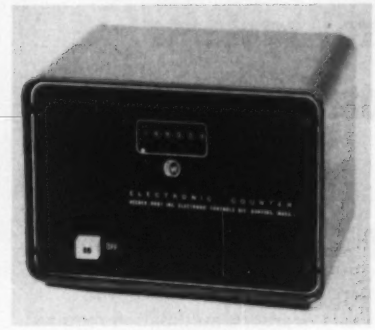
B-I-F continuous liquids-to-solids proportioning system adapts to a wide range of applications. Spray nozzle easily applied on liquid unit. Request complete details . . . write for free facts today!

B·I·F *Industries*

BUILDERS-PROVIDENCE • PROPORTIONEERS • OMEGA
527 HARRIS AVENUE, PROVIDENCE 1, RHODE ISLAND

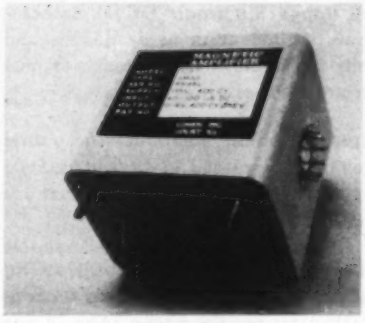
Circle 719 on Page 35

nel device for high speed lineal measuring. This measuring unit is a twin photohead device, used in



conjunction with rotating rolls over which material is passed when length measurement is required. It is applicable for counting such materials as wire, cable, paper, cloth, and film. **Electronic Controls Div., Veeder-Root Inc.**, Danvers, Mass.

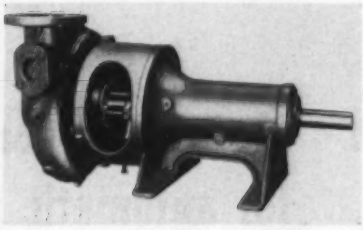
Circle 475 on Page 35



Magnetic Amplifier

Line of servo magnetic amplifiers has been designed to meet a wide range of environmental conditions including high and low temperature, humidity, mildew resistance, sand and dust, and vibration. Unit is a push-pull servo amplifier of extreme sensitivity. It has signal input level of ±100 microamps at an input impedance of 500 ohms. Output is 26 volts with a power rating of 3.1 watts. The null voltage of Model 1057 servo amplifier remains below 0.5 volt for any 10 per cent change in voltage and frequency throughout the operating range specified. Supply voltage is 113 volts ±10 per cent, and supply frequency is 400 cps ±4 cycles. **Lumen Inc.**, Moen Ave., P. O. Box 905, Joliet, Ill.

Circle 476 on Page 35



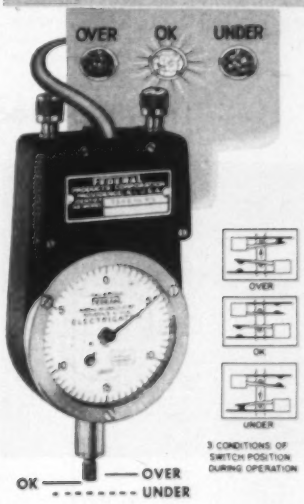
Centrifugal Pump

Line of Adapt-Able centrifugal pumps is useful for a variety of liquid handling applications such as corrosive liquids, solids in suspension, nonabrasive materials such as bottle labels, leaves, feathers, or other small solids in general pumping service or on original equipment. Dimensions of each pump align with those of NEMA-rated motors for ease of mounting and trouble-free operation. Pump frames receive various size volutes and impellers. Pumps are available in various mountings. **Pump and Hydraulic Div., Fairbanks, Morse & Co.**, Kansas City, Kans.

Circle 477 on Page 35

GAGE PAGE

A Quick Run-down of New Gaging Ideas

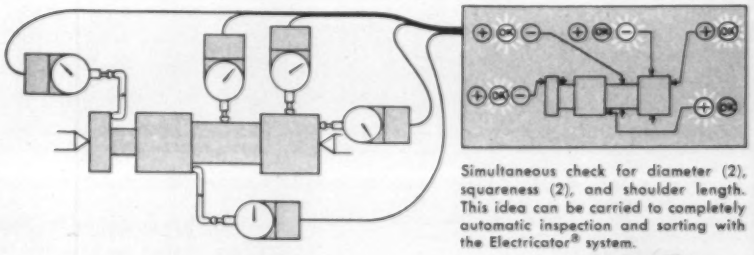


PAINLESS UPGRADING

Want faster, more reliable gaging with less skilled help, less operator fatigue . . . and at a modest price?

Electrify your operation with the FEDERAL Electricator® high accuracy unit . . . a Dial Indicator and precision switch combined. Replaces any AGD Group 2 (C size) Indicator . . . gives you light signals for "over", "under" and "good" . . . instantly. No borderline decisions to make, no dials to read, less chance of human error. Easily set to blocks. Good for tolerances down to ±.00025". Tolerance (switching) limits adjustable from on top.

What a job it does on multiple dimension fixtures (diagram)! No redesign necessary. Light panel gives you whole story at a glance. You can automate, too, with the Electricator® system.



Simultaneous check for diameter (2), squareness (2), and shoulder length. This idea can be carried to completely automatic inspection and sorting with the Electricator® system.

For complete specs, dimensions — the *whole* story — send for Catalog 60 AM.

FEDERAL PRODUCTS CORPORATION
1394 EDDY STREET, PROVIDENCE 1, R. I.

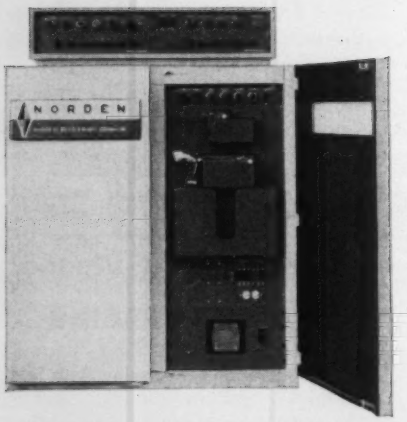
Ask **FEDERAL®** *First*

FOR RECOMMENDATIONS IN MODERN GAGES . . .

Dial Indicating, Air, Electric, or Electronic—for Inspecting, Measuring, Sorting, or Automation Gaging

Circle 720 on Page 35

NORDEN Modumatic control systems for automatic positioning



The Norden Series 600 is a numerical control system for automatic point-to-point linear or rotary positioning.

This system features a new concept in numerical control with modumatic design permitting the exact degree of automation required.

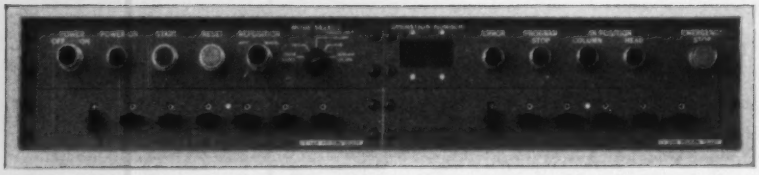
This new concept is achieved by an exclusive design utilizing an absolute digital feedback transducer, electronic circuitry, and visual display. It offers complete automatic positioning with input from either manual dial-in or punched tape. Display units provide continuous decimal readout of *actual* position—not command.

NORDEN 600 SERIES FEATURES:

Full Range Electronic Origin Select—allows desired offset to be quickly and easily dialed in by the operator on manual selector switches.

Actual Position Readout—the actual position is displayed in straight decimal form by illuminated numbers that are readable from twenty feet.

Full Range Electronic Positioning Select—allows positioning to be controlled manually or by tape. Tape program can be interrupted to insert additional or intermediate operations.



Controlled Programming—with automatic tape punch equipment, tapes may be prepared "on the machine" providing a permanent inspection record or a programmed tape for playback applications.

For complete details on the Series 600, or other modumatic control systems, contact your nearest Norden Representative—400 Main Street, East Hartford, Connecticut, JAckson 8-8411—11 West Ave., Dayton 2, Ohio, BAldwin 8-4481, or write to us at the address below.

NORDEN DIVISION OF UNITED AIRCRAFT CORPORATION
DATA SYSTEMS DEPARTMENT
3501 HARBOR BOULEVARD, COSTA MESA, CALIFORNIA

Circle 721 on Page 35

AUTOMATION

catalogs and literature

Latest automation information. For copies use card on page 35.

Special Production Equipment

Kirkhof Manufacturing Corp., 2450 Buchanan Ave. S.W., Grand Rapids 7, Mich.—8 page bulletin—Bulletin E60-1 presents capsule case histories of equipment manufactured to meet special requirements of the metal working industry. It covers such equipment as resistance and arc welders, welding guns and stations, jigs and fixtures, mechanical handling equipment, automation systems, and assembly presses. Photographs accompany various descriptions.

Circle 478 on Page 35

Cam Follower Bearings

Bearing Div., McGill Mfg. Co. Inc., Valparaiso, Ind.—4 page pamphlet—Data on a line of heavy stud cam follower bearings are provided in this brochure. Both CFH and SCFH (sealed) Series are listed. Schematic diagrams illustrate construction details. Dimensional tables are provided as well as charts indicating various specifications.

Circle 479 on Page 35

OBI Presses

Niagara Machine & Tool Works, 683 Northland Ave., Buffalo 11, N. Y.—6 page pamphlet—Series M line of open-back inclinable presses, arranged for automatic ultra-high speed operation with progressive dies, is described and illustrated in Bulletin 54. Included are standard specifications, die space dimensions, and stroke-shutheight data for 22, 35, 45, and 60-ton capacity models. Presses are available in 4 sizes (both nongeared and single geared) with shaft dimensions from 2½ to 4 inches.

Circle 480 on Page 35

Materials Handling Systems

Rapids-Standard Co. Inc., 342 Rapistan Bldg., Grand Rapids, Mich.—4 page pamphlet—Form 2500 discusses 18 ways to reduce handling costs. It points out the often-forgotten areas of storage, transfer, and control, giving specific methods for reducing costs in these phases of handling as well as in the movement of goods. For each of the ways to cut costs, there is a photograph of an actual application with information on the equipment used. Problems involving the positioning of goods for order selection, the handling of materials on pallets, the moving of goods between floors, the accumulation of cartons on a conveyor line, and many other functions of materials handling equipment are illustrated. Details are also provided on a line of APC pressure-sensing conveyors.

Circle 481 on Page 35

Filter Cartridges

Cuno Engineering Corp., 80 S. Vine St., Meriden, Conn.—4 page pamphlet—Bulletin MW-100 covers a line of Micro-Wynd filter cartridges designed to set high performance standards in filtering a wide variety of fluids including plating solutions, alcoholic beverages, fuels, and chemical process streams. Designed specifically to achieve balance between filterability and body strength, these cartridges deliver sustained micronic cleaning. They feature an accurate degree of filtration, high flow rates, large dirt holding capacity, and long service life.

Circle 482 on Page 35

Electrical Components

Surplus Div., Servo-Tek Products Co., 1086 Goffle Rd., Hawthorne, N. J.—30 page catalog—Catalog 75 illustrates and describes various synchros, ac and dc motors, servo motors, inverters, actuators, geared motors, generators, etc. Curves of servo motors, circuit diagrams, and schematics are also depicted.

Circle 483 on Page 35

Flame-Cutting Machines

Linde Co., Div., Union Carbide Corp., 270 Park Ave., New York 17, N. Y.—28 page catalog—Line of Oxweld flame-cutting machines is outlined in Catalog F-1396. Machines described range in size from small, portable ones that can be carried by one man to multitorch shape-cutting machines capable of reproducing tens or thousands of intricate shapes and patterns in steel. Details are provided on a photocell tracer that makes it possible to reproduce complicated metal parts from exact-size pencil or ink drawings. Typical installations are illustrated, and various machine accessories are described.

Circle 484 on Page 35

Fluid Power Valves

Ross Operating Valve Co., 120 E. Golden Gate Ave., Detroit 3, Mich.—8 page bulletin—Data on Headline series of fluid power valves available in 25 different models are provided in Bulletin 323. Specifications, features, C_v factors, and response times of these lightweight poppet type control units are given. Models are grouped in straightway, 3-way and 4-way types with various solenoid and air-operated heads and pipe sizes from ¼ to 1½ inches.

Circle 485 on Page 35

Armature Winder

Possis Machine Corp., 825 Rhode Island Ave., Minneapolis 26, Minn.—2 page pamphlet—Bulletin 605-AL describes an armature winder featuring an automatic commutator lug hook-up. Entire unit is powered by hydraulics and is capable of winding speeds up to 3000 rpm. Armature diameter is ½ to 2½ inches; armature length may be up to 3¼ inches (maximum distance from center of stack to end of shaft, 7 inches).

Circle 486 on Page 35

Electromagnetic Relays

Potter & Brumfield Div., American Machine & Foundry Co., Technical Information Section, Princeton, Ind.—16 page booklet—Line of electromagnetic relays is covered in Catalog 60. Comprehensive engineering data on 42 different series of relays is included. The various relays are divided into 4 major groups: Telephone type, military, power, and general purpose. Majority of information is presented in the form of charts for ready comparison between like kinds of relays.

Circle 487 on Page 35

Thermocouple Selector Switches

Thermo Electric Co. Inc., Saddle Brook, N. J.—4 page pamphlet—Catalog 24-2 describes a line of compact multipoint thermocouple selector switches designed for applications where the temperatures being sensed by a number of thermocouples or resistance thermometers must be checked frequently, where the sensors must be switched from one measuring instrument to another, or where a measuring instrument must be switched to different meas-

uring points. Described in detail are a rotary switch with 6, 12, or 24 point capacity; key switches for up to 144 points, and pushbutton models for up to 72 point operation. These switches are suitable for use with all types of thermocouples or resistance thermometers and pyrometers.

Circle 488 on Page 35

Industrial Hose

Aeroquip Corp., Advertising Dept., Jackson, Mich.—12 *page booklet*—Bulletin 627 serves as a guide for proper hose selection for virtually every industrial application. Listed are 112 separate liquids and gases, beginning with acetate solvents and ending with zinc salt solutions. Charts indicate resistance of various tube stocks to each agent. A separate chart provides fundamental information about pressure, temperature, and size limits of individual hose types.

Circle 489 on Page 35

Fluid Power Cylinders

Mo-Bar Hydraulics Co., Crystal Lake, Ill.—3 *booklets*—Bulletin 202 contains data regarding a line of Series *a* pneumatic cylinders designed for pressures up to 200 psi. Series *m* hydraulic cylinders, described in Bulletin 203, have pressure ratings from 500 to 2000 psi. Bulletin 204 covers Series *h* hydraulic cylinders for high pressures from 2000 to 3000 psi. Schematic diagrams illustrate construction features of the various models as well as mounting data and styles.

Circle 490 on Page 35

Digital Computer System

Control Data Corp., 501 Park Ave., Minneapolis 15, Minn.—14 *page booklet*—Booklet contains information regarding an all-transistorized digital computer system. Model 1604 data computer is suited for performing large volume data processing and for solving large scale scientific problems. Storage system of the unit is a large capacity magnetic core storage system that provides high-speed nonvolatile random-access storage for 32,768 48-bit words. Input-output facilities of the systems are illustrated by means of a schematic diagram.

Circle 491 on Page 35

Seam Welder

Sciaky Bros. Inc., Dept. L-29, 4915 W. 67th St., Chicago, Ill.—8 *page bulletin*—Model MPT-2 air operated, press type, three-phase seam welder designed to cover a wide range of commercial and military welding applications is subject of Bulletin 320-8. Machine data is tabulated to indicate available kva range, throat depths, welding currents, electrode forces, etc. Three-phase principle of operation utilized by the welder is explained in detail.

Circle 492 on Page 35

Fractional Horsepower Motor

Reliance Electric & Engineering Co., Cleveland 17, Ohio—8 *page bulletin*—Bulletin B-2514 provides details on a fractional horsepower Duty Master Motor. In 1/20 through 3/4 hp sizes, motor features a new ventilation system that makes it up to 10 per cent cooler than other comparably rated motors. Weight has been reduced 33 per cent from preceding motor designs. Maximum protection is provided in enclosure with compact magnetic electrical parts designed to produce size and weight reductions. Complete line includes split phase, repulsion start, fan-cooled explosion-proof, capacitor, and vertical C-face models.

Circle 493 on Page 35

Automatic Transmission

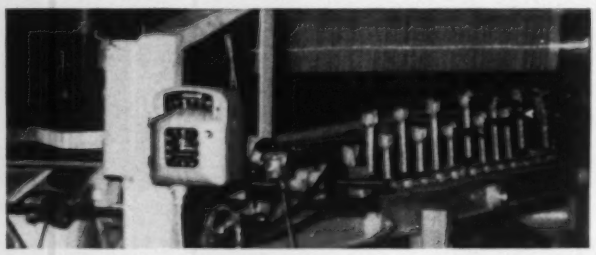
Morse Chain Co., Ithaca, N. Y.—8 *page bulletin*—Subject of Catalog PFT-60 is an automatic transmission, designated Power-Flow, with ratings up to 25 horsepower. This transmission may be adapted as a constant speed regulator which makes it ideally suited for industrial control applications. It can also be used as an automatic clutch transmission. Typical applications are listed and illustrated. A drive selection chart is included.

Circle 494 on Page 35

Overhead Trolley Conveyors

Rapistan-Keystone Inc., 21750 W. Eight Mile Rd., Detroit 41, Mich.—6 *page pamphlet*—Line of power and free overhead trolley conveyors is covered in Bulletin 2365. These conveyors utilize switches, retarders, and trolley stops to effect full time control over materials in motion. Model 228 has a capacity of 135 lb per trolley; heavy duty Model 348 has a capacity of 250 lb. Photographs illustrate typical installations.

Circle 495 on Page 35



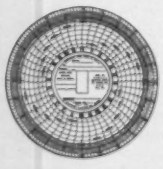
At Burlington Mills . . .

A WAGNER® INDUSTRIAL RECORDING SYSTEM

records slasher production

Burlington Mills uses an Industrial Tachograph to measure the production efficiency of this slasher. The Tachograph is a precision recording device that lets you measure output versus time. It can be used wherever the control of speed, time and measurement is essential to the quality of your products.

Tachographs graphically record operation of one machine or an entire line...aid in quality control and time study programs ...help you determine production peaks and valleys, and non-productive time. Chances are, Tachographs can help increase your mill's efficiency. Mail coupon below for full information.



Wagner Electric Corporation
6430 PLYMOUTH AVE., ST. LOUIS 33, MO., U. S. A.

Please send a copy of Bulletin SU-144.

Name_____
Company_____
Address_____
City & State_____
Proposed Application_____

W181-1

Electric Hydrometer

Liquidometer Corp., Long Island City 1, N. Y.—16 *page booklet*—Bulletin 522A describes applications of an electric hydrometer, designated the Liquidensitometer. Among the applications described are those which require direct measurement of liquid density either to directly indicate density (or specific gravity) or to provide gravimetric correction for liquid flow or tank contents indicating systems. Schematic diagrams illustrate various details of the device.

Circle 496 on Page 35

Electronic Computing Systems

Data Processing Div., Royal McBee Corp., Port Chester, N. Y.—2 *page pamphlet*—Line of RPC-4000 electronic computing systems is covered in Bulletin S-482. These fully transistorized, stored program, general purpose computing systems are designed for both engineering and business data processing. A basic system consists of a computer and punched paper tape typewriter input-output unit.

Circle 497 on Page 35

Cushion Couplings

Dodge Manufacturing Corp., Mishawaka, Ind.—20 *page booklet*—Two new types of Para-flex flexible cushion couplings: One for high speed, high torque applications and the other for attachment to flywheels of internal combustion engines, are described in Bulletin 901. Data also cover the standard Para-flex with its tire-shaped flexing member of cord and rubber construction. All three couplings are recom-

Circle 722 on Page 35

mended to accommodate angular and parallel shaft misalignment and end float, to absorb vibration, and to cushion shock loads.

Circle 498 on Page 35

Gas Chromatograph

Mine Safety Appliances Co., 201 N. Braddock Ave., Pittsburgh 8, Pa.—4 page pamphlet—Tape programming, utilized to achieve greater precision and flexibility in process stream analysis by chromatography, is described in Bulletin 0714-5. Featured is a gas chromatograph that has a high degree of stability in column temperature and permits either bar graph, spectrum, or manual chromatographic presentation. Photographs and diagrams illustrate the controller, in a locked dust-proof housing, and the analyzer, in an explosion-proof housing.

Circle 499 on Page 35

Pressure Transducers

Standard Controls Inc., 1130 Poplar Place, Seattle 44, Wash.—series of data sheets—Data folder contains a glossary of pressure transducer definitions and describes SP-2 Series pressure transducers. These transducers cover the range of 0-300 through 0-5000 psig. The following models are available: Model 100 for applications requiring accurate measurements of pressure taken in a small space under severe environmental conditions; Model 200 a ruggedized, flexible version of the basic unit; Model 300 originally designed as a small pickup for use in the measurement of rocket nozzle pressures; and Model 600 especially designed to make differential measurements at full system pressures.

Circle 500 on Page 35

Bending Machines

Pines Engineering Co. Inc., 601 Walnut St., Aurora, Ill.—24 page catalog—Catalog 356 covers a line of bending machines for tubing pipe, extrusions, and rolled sections. Various models as well as typical applications are illustrated. Details are also provided on tube and rod end-finishing machines for deburring, facing, inside and outside chamfering, and pointing.

Circle 501 on Page 35

Temperature Controls

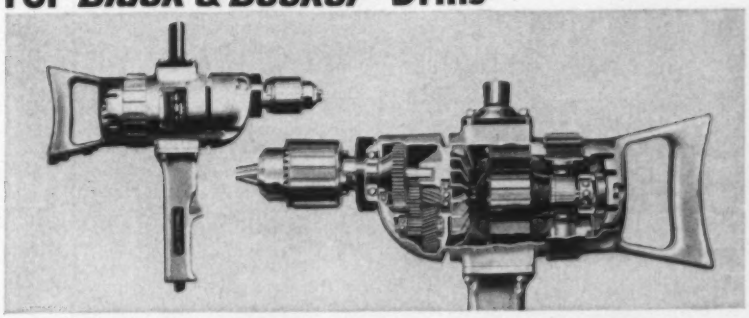
United Electric Controls Co., 85 School St., Watertown 72, Mass.—6 page pamphlet—Data on a line of temperature controls are provided in Catalog 400. Both local mounted and remote bulb general purpose controls are covered. Applications of special purpose controls are illustrated and described.

Circle 502 on Page 35

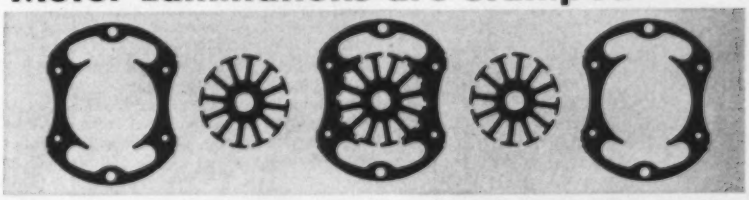
Pneumatic Positioner

Conoflow Corp., 2100 Arch St., Philadelphia 3, Pa.—2 page pamphlet—Line of Series 50 Conomotor actuators is subject of Data Sheet 102. These pneumatic actuators are widely used for precisely positioning many types of mechanical processing equipment including variable speed drives; butterfly valves; control

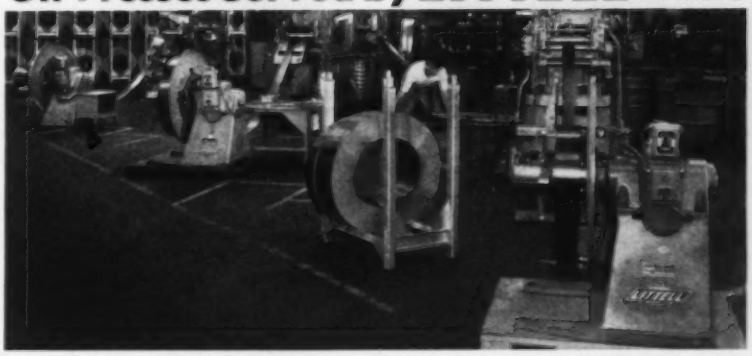
For *Black & Decker* Drills



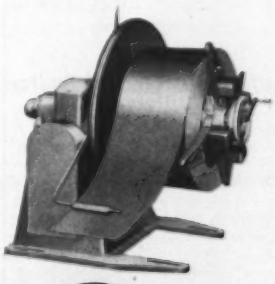
Motor Laminations are Stamped



On Presses Served by *LITTELL* Reels



Black & Decker Drills are power-built to last, and rugged B&D-built motors are a major factor in their staying power. Rotor and Stator laminations for these compact motors are precision stamped from coil stock at Black & Decker's Hampstead, Maryland plant. Littell Automatic Centering Reels pay out the coil at a controlled pace that is automatically self-adjusted to the speed of the press. To assure the smooth synchronization of reel and press necessary to uniform laminations, Black & Decker depends on Littell Spindle Reels. Series "D" Littell Catalogs describe them.



No. 25-18
Motor Driven Automatic Centering Reel used by Black & Decker and ready to serve you. Handles coils up to 2500 lbs., 18" wide.

F. J. LITTELL MACHINE CO.

Coily says... "There's a LITTELL Reel for every coil and every press. Get the facts. Write for Catalog Series D."

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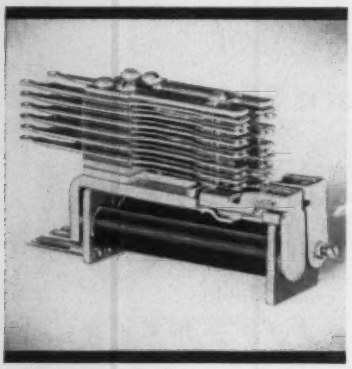
Circle 723 on Page 35

Relays by Stromberg-Carlson



Telephone-type quality • reliability durability

If you require reliable, durable, top quality relays in the equipment you manufacture, you're well advised to consider the relays made by Stromberg-Carlson.

Hundreds of companies have found here the advantages based on our over sixty years of specialization in providing equipment and parts to the independent telephone world.

What's more, we go beyond just the manufacture of relays. If you desire, we can also provide wired mounting assemblies.

Our relays are available in a wide range of types, of which these are representative:

TYPE A: general-purpose. Up to 20 Form "A" spring combinations.

TYPE B: gang-type. Up to 60 Form "A" spring combinations.

TYPE BB: up to 100 Form "A" springs.

TYPE C: (illustrated) two on one frame. Ideal where space is tight.

TYPE E: characteristics of Type A, plus universal mounting. Interchangeable with other makes.

Types A, B, and E are available in high-voltage models. Our assembly know-how is available to guide you in your specific application.

Details on request from these Stromberg-Carlson offices: Atlanta—750 Ponce de Leon Place N.E.; Chicago—564 W. Adams Street; Kansas City (Mo.)—2017 Grand Avenue; Rochester—1040 University Avenue; San Francisco—1805 Rollins Road.

STROMBERG-CARLSON
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GENERAL DYNAMICS | ELECTRONICS

Circle 724 on Page 35

valves; proportioning pumps; and electrical components such as rheostats, autotransformers, and potentiometers. Actuator can be supplied in various sizes with stroke lengths from ¼ through 24 inches.

Circle 503 on Page 35

Fluid Power Equipment

Oilgear Co., 1571A W. Pierce St., Milwaukee 4, Wis.—4 page pamphlet—Fluid Power News 14 describes and illustrates solutions, taken from application engineering files, to various problems through the application of fluid power equipment in the metal producing and working industries. Covered in this issue are: A fluid power system for hydrostatic pipe testing machines; the replacement of a mechanical system by a simplified fluid power and control system for a 300-ton stationary ingot stripper; a fluid power linear drive with electrohydraulic control to replace an electric drive on steel ingot manipulator; and an automatic press for conversion of bulky metal turnings and borings into dense, uniform briquettes.

Circle 504 on Page 35

Screw Holding Devices

Magna Driver Corp., 779 Washington St., Buffalo 3, N. Y.—20 page catalog—A line of Magna-Tip magnetic screw holding accessories for power screw drivers and nut setters is described in this catalog. These accessories are designed to fit all standard slotted head, Phillips, Freason, clutch and Allen recessed head screws as well as hexagon head screws. Catalog is divided into six sections which cover, respectively, permanently magnetic hand screw and nut drivers; bit holders and bits; finders and extensions; power bits; shanks and adapters; and sockets.

Circle 505 on Page 35

Thickness Testing Methods

Twin City Testing Corp., 533 S. Niagara St., Tonawanda, N. Y.—18 page booklet—Included in this brochure is an informative description of various nondestructive methods currently employed for measuring the thicknesses of organic and nonmagnetic metal coatings (including phosphate) on iron and steel. The advantages and limitations of each method are discussed. Applications and features of a Model ES Permascope (permeability type) thickness tester are described.

Circle 506 on Page 35

Automatic Control Systems

CompuDyne Corp., Hatboro, Pa.—24 page handbook—Brochure titled "Capabilities of CompuDyne Corporation" features the products and research, development, and manufacturing services of this company's divisions and subsidiaries. Systems described are used to regulate various processes. Examples include water level control in the hydro-electric power industry, temperature regulation in the food processing industries, process control in the chemical industry, and automatic control of precision settings for machine tools. Automatic weighing systems covered are utilized in many industries including steel, cement, chemical, food, petroleum, paper, and plastics.

Circle 507 on Page 35

Precision Machine Tools

Taft-Peirce Mfg. Co., Woonsocket, R. I.—16 page booklet—Details on a line of surface grinders and lapping machines are provided in Catalog 318. Explained are the important features that have been added to a No. 1 precision surface grinder, a 6-inch rotary grinder, a 24-inch semi-automatic lapping machine, a 24-inch rotary lapping machine, and a back spotfacing machine. Also described are many accessories and attachments designed to extend the versatility of these and other machine tools.

Circle 508 on Page 35

Attrition Mills

Robinson Div., Young Machinery Co. Inc., Muncy, Pa.—8 page bulletin—Bulletin A-560-A covers motor and belt-driven double runner mills, Frigidisc single runner water cooled mills, Attritor pressure-fed single runner mills, as well as a line of Junior Disc single runner mills for laboratory, pilot plant, and small capacity operations. Dimensions, weights, and capacity specifications are given in addition to details on feeding mechanisms, drives, design features, and specific applications. Attrition mill plates are also illustrated and described.

Circle 509 on Page 35

Load Indicator

Danly Machine Specialties Inc., 2100 S. Laramie Ave., Chicago 50, Ill.—8 page bulletin—Bulletin LI-1 describes a load indicator that is designed to provide a simple, visual means for determining the condition of loading in a machine. Basically, the load indicator consists of one or more sensing units, a control unit, and an indicator. Indicator units are available in four types; standard, relay, high-speed, and high-speed relay. Various system applications are illustrated.

Circle 510 on Page 35

Gear Finishers

Michigan Tool Co., 7171 E. McNichols Rd., Detroit 12, Mich.—8 page bulletin—Bulletin 870-60 contains data on a line of Mark II gear finishers. It covers three methods of shaving that can be used: Underpass, transverse, and modified underpass. Details are provided on two machine attachments—one for crowning, tapering, or crown-taper shaving, and the other for sensing excess stock on the workpieces so the machine will shut down to protect the cutters. Complete machine specifications are given for three types and several sizes of machines for finishing external spur and helical gears, and internal gears.

Circle 511 on Page 35

Speed Measurement Systems

Meriam Instrument Co., 10920 Madison Ave., Cleveland 2, Ohio—4 page pamphlet—Bulletin 1000 describes the operation and selection of a line of self-generating, 3-phase electric speed measurement systems. Designed for heavy-duty operation in both hazardous and non-hazardous atmospheres, these systems will measure rotary movements with accuracy of 0.3 per cent of full scale within the linear range. Bulletin is divided into four component part sections—electrical tachometer generators, electrical tachometer indicators, explosion-proof housings, and

electromechanical vibrators. Emphasis is placed upon electrical tachometer indicators with 6-inch dials (66 inches of scale) and 3-inch dials (33 inches of scale) for specified drive ratios up to 35,000 rpm.

Circle 512 on Page 35

Servo Indicators

Industrial Div., Minneapolis-Honeywell Regulator Co., Wayne & Windrim Ave., Philadelphia 44, Pa.—4 page pamphlet—Specification FS-301-9 contains data on Electrik Tel-O-Set indicators and indicating control stations which continuously indicate and record the standard 4-20 ma dc output of any of the company's transmitters or transducers. All of these units contain an integral, transistorized power supply that makes possible true two-wire transmission from field mounted devices. Controller specifications, dimensions, and features are included.

Circle 513 on Page 35

Endless Woven Belts

Arthur S. Brown Mfg. Co., Tilton, N. H.—7 pamphlets—Illustrated brochures cover endless woven flat and round belts used for transmission drives and conveyor systems. Pamphlets describe the operating characteristics, features, and capabilities of the belts in such equipment as computers, duplicators, sound recorders, printing equipment, precision grinding and drilling machines, and textile and shoe machinery.

Circle 514 on Page 35

Ball Bearing Screws and Splines

Saginaw Steering Gear Div., General Motors Corp., Saginaw, Mich.—24 page catalog—Basic principles, types, and applications of a line of ball bearing screws and splines are illustrated and described in Booklet 61-E. Design data, sample problems, and information on lubrication, size ranges, critical speeds, finishes available, and mounting methods are provided. Ball bearing screws offer high efficiency at low torque for actuating and positioning functions. Ball bearing splines provide easy linear movement, even when functioning under high torque or bending loads.

Circle 515 on Page 35

Electromagnetic Drives

Westinghouse Electric Corp., P. O. Box 2099, Pittsburgh 30, Pa.—12 page booklet—Bulletin 7875 describes a line of Magna-Flow electromagnetic drives for conveyors, fans and pumps, winders, metal slitting and forming machines, paper mill machinery, and wherever the need for speed control exists. Details are included on how the drives work, what they include, and where they are used. Various types of drives, such as air cooled integral and fractional, and liquid cooled units, are discussed.

Circle 516 on Page 35

Magnetic Tape Instrumentation

Sangamo Electric Co., Springfield, Ill.—8 page bulletin—A new concept in magnetic tape instrumentation is the subject of Bulletin 3400. Details are provided on a Series 460 recorder/reproducer that can

with **LIPE**
Automatic Machine Loading

● You can meet and beat competition by getting peak production from every machine in your shop — new *and* old. Lipe Automatic Machine Loading delivers at least 90% of the gross geared capacity of any production machine, because stock is fed continuously. Your machines cut stock — not air!

● Lipe AML Bar Feeds automatically feed stock of practically every length, shape and material, in close-tolerance feedouts. Users report production increases of 40% . . . 90% . . . and even 200% per machine, plus labor benefits that are even more important. Workers are freed from back-breaking hand-loading of stock . . . concentrate on quality and machine set-ups. For a free estimate of what Lipe AML can do for your shop, send prints or samples of typical work. Write for full information.

Stop Cutting Air and You Start Cutting Costs

Lipe-ROLLWAY CORPORATION SYRACUSE 1, N. Y.

PIONEERS IN PNEUMATIC BAR-FEEDING

Circle 725 on Page 35

instantly be changed from reel to loop operation without rehandling the tape or making any changes in the transport other than operation of the controls. Unit features fully transistorized electronic circuitry and a modular power supply. Resulting characteristics of this new magnetic tape concept are listed.

Circle 517 on Page 35

Temperature Controls

Fenwal Inc., Pleasant St., Ashland, Mass.—8 *page bulletin*—Transistor circuits and thermistor sensing elements are among the features of the four transistorized temperature controllers described in Bulletin MC-190. Detailed specifications are given for the 536 nonindicating controller, 561 indicating, 582 thermometer, and 580 indicator accessory for the 536. Optional features include proportioning or *On-Off* control action, several temperature ranges and scales, and remote or local control. Sketches indicate various application arrangements.

Circle 518 on Page 35

Single Crank Presses

Federal Machine and Welder Co., Warren, Ohio—8 *page bulletin*—Bulletin 52181 covers a line of single-action, straight side, single crank presses in capacities from 60 to 400 tons. These presses are available with speeds of 30 or more strokes per minute with single back gearing and can be equipped with double gearing for slower speeds. Schematic diagrams indicate various construction features of the machines.

Circle 519 on Page 35

Nondestructive Test Equipment

Sperry Products Co., Div., Howe Sound Co., Danbury, Conn.—12 *page booklet*—Data on ultrasonic testing equipment, portable industrial x-ray equipment, and magnetic particle inspection equipment and supplies are contained in Bulletin 00-105. Inspection methods are explained, and various applications and accessories are illustrated. Details are provided on both standard and automated Simac ultrasonic inspection systems.

Circle 520 on Page 35

Vacuum Furnaces

Lindberg Engineering Co., 2444 W. Hubbard St., Chicago 12, Ill.—8 *page bulletin*—Bulletin 800 describes and illustrates a line of vacuum type furnaces. These furnaces are capable of temperatures up to 3000 F. Work spaces range from 3 in. diameter by 24 in. long up to 48 in. wide, 48 in. high, and 12 ft long. Vacuum furnaces covered in this brochure include such types as hot-wall vertical retort, horizontal retort, bell-type, cold-wall, and a vacuum-atmosphere retort tube for research and pilot-plant use.

Circle 521 on Page 35

Analog Computer

Computer Systems Inc., Culver Rd., Monmouth Junction, N. J.—7 *page report*—Form 80-105-009 describes solutions to multicomponent phase equilibrium problems using a Dystac analog computer. The problem discussed is a multicomponent system in which equilibrium temperature, pressure, L/V ratio, and liquid vapor compositions are calculated when the concentration of a given component in either the liquid or vapor phase is specified. The computer provides almost instantaneous solution after problem setup. The method disclosed is generalized and can be used for any number of components.

Circle 522 on Page 35

Static Transductors

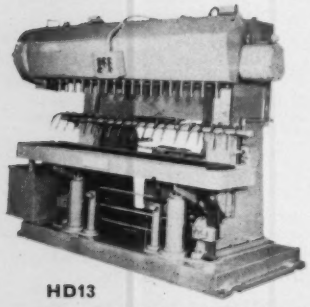
Control Div., Magnetics Inc., Butler, Pa.—38 *page catalog*—Manual T-11 describes a line of static transductors which can be used for measuring direct current. These transductors, used for measuring dc, may be noncompensated where bus bar proximity and centering create no special problems, or compensated where such problems are encountered. Details are also presented on a Type 4521 transductor which is used for measuring dc voltage. Details are given on a summation system used in a continuous strip plating mill. System includes a transformer for summing outputs of 18 transductors.

Circle 523 on Page 35

Filling Machines

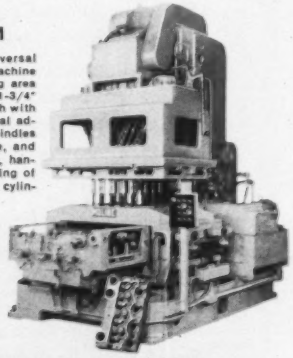
J. L. Ferguson Co., Sales Dept., P. O. Box 1226, Joliet, Ill.—4 *page pamphlet*—Brochure 100-58 illustrates and describes a number of Packomatic filling machines for handling semi or nonfree-flowing solid products, measured precisely by weight or volume. It provides details on the following machines: Telescoping volumetric filler; single auger packer, and turret type multiple station auger packer-weigher.

Circle 524 on Page 35



MODEL HU111

Hydraulic Feed, Universal Joint-Type Drilling Machine with 24" x 50" drilling area and with forty-two 1-3/4" spindle drivers, each with two-speed and neutral adjustment. Thirty-six spindles in slip spindle plate, and power shifting fixture, handle drilling and reaming of three different engine cylinder heads.



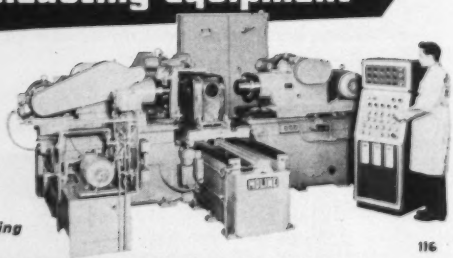
HD13

straight line drilling machine with hydraulic table feed and 18 spindles each having 11/16" diameter drill capacity in mild steel. Spindle center distances are adjustable along the 6-foot machine rail.

MOLINE Cost Reducing Equipment

MODEL MR148

Three-way, three-spindle, horizontal boring machine with selective automatic feed cycle. Handles boring of cylinder and crank bore for 3 sizes of 1-cylinder blocks. Also bores for wet sleeves in 2- and 3-cylinder blocks.



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116

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REPRESENTATIVES IN PRINCIPAL CITIES

Circle 726 on Page 35

Moisture Analyzer

Manufacturers Engineering & Equipment Corp., York Rd. & Sunset Lane, Hatboro, Pa.—8 *page bulletin*—Booklet contains data on a Model W electrolytic moisture analyzer for measurement of moisture in liquids such as petroleum solvents, jet fuels, silicones, dielectric liquids, etc. Device maintains accurate sample flow regulation, effective stripping, and includes a built-in oil separator and a liquid condenser. Both explosionproof and nonexplosionproof models are available.

Circle 525 on Page 35

Ball Bearing Units

Sealmaster Bearing Div., Stephens-Adamson Mfg. Co., Ridgeway Ave., Aurora, Ill.—64 *page catalog*—Specifications, diagrams, illustrations, and typical applications of a line of ball bearing units are provided in Catalog 454. Permanent seal, prelubrication, self-aligning, and zone hardening features of the units are pointed out.

Circle 526 on Page 35

Process Control Systems

Bailey Meter Co., 1050 Ivanhoe Rd., Cleveland 10, Ohio—4 *page pamphlet*—Bulletin E74-1 describes a series of solid-state electric control systems which are designed to produce process variable outputs in accordance with desired or set point conditions. These systems utilize

such primary measuring elements as thermocouples, strain gages, resistance temperature detectors, or movable core transformers. These signals are then processed to provide actuation of electrical or pneumatic final control elements. Systems are designed for use in petroleum, steel, chemical, power, paper, and rubber processing plants.

Circle 527 on Page 35

Power Presses

Havir Mfg. Co. Inc., 444 Cleveland Ave., St. Paul, Minn.—8 page bulletin—Brochure contains data on a line of power presses, designated Press-Rite. Available in from 2 through 85-ton capacities, these presses feature automatic feed. New 55 and 70-ton models are available with Airflex air friction clutch and air-applied brake designed for long, maintenance-free life. Photographs illustrate several different models.

Circle 528 on Page 35

Aluminum Machining Data

Kaiser Aluminum & Chemical Sales Inc., Kaiser Center, 300 Lakeside Drive, Oakland 12, Calif.—104 page handbook—Manual contains advanced machining data for aluminum part production on automatic screw machines. Details are provided on machining speeds and feeds, cutting fluids, and raw material packaging. Also provided are various charts indicating possible trouble spots.

Circle 529 on Page 35

Turbine Flowmeter

Potter Aeronautical Corp., Route 22, Union, N. J.—4 page pamphlet—Data on a turbine flowmeter, Micro-Meter Series 4000, are provided in Bulletin D-225. Flowmeter is capable of measuring extremely low flow rates for such applications as pilot plants, laboratory work, and metering of additives in minute quantities with a repeatability of ±0.25 per cent of reading. A sizing chart indicates meter sizes required for various flow ranges from 0.004 to 0.6 gpm.

Circle 530 on Page 35

Abrasives Impeller

Pangborn Corp., Hagerstown, Md.—8 page bulletin—Bulletin 227A contains data relating to a Rotoblast impeller that uses controlled centrifugal force for its blast cleaning power. Manufactured in four sizes, this device is designed to meet specific blast cleaning requirements and is suitable for a variety of applications. Diagrams and cutaway drawings of the unit are provided.

Circle 531 on Page 35

Batch Weighing Systems

Gilmore Industries Inc., 13015 Woodland Ave., Cleveland 20, Ohio—20 page handbook—Data on automatic electric batch weighing systems are covered in Bulletin B-100. Details are provided on six different weighing systems. Applications range from low cost, short run installations where the formula is frequently varied all the way to complicated production batch weighing runs.

Circle 532 on Page 35

Just off the plane and HERE COMES YOUR LUGGAGE

Luggage-claiming area at United Air Lines' bright new terminal at New York's Idlewild International Airport.

AN AIR TRAVELER'S DREAM COME TRUE!

You have just stepped off a plane with 100 other jet-age travelers, and already a high-speed belt conveyer system is delivering your luggage to the claiming counter. The traveling diverter is distributing the luggage evenly along the rail, and all of you will be on your way, with your luggage, in a matter of just a few minutes. This system of belt conveyers is a good example of **Outstanding Performance** — the extra you get in Mathews Conveyers.

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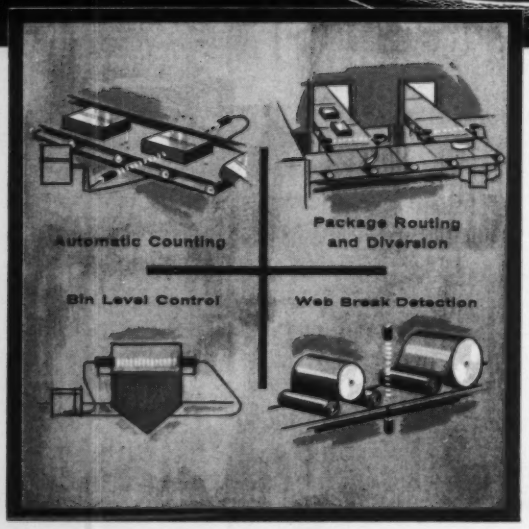
Over Fifty Years of Leadership in Mechanized Handling

Circle 727 on Page 35

a new dimension in automated controls

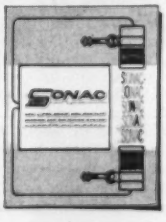


SONAC ULTRASONIC,

NON-CONTACT SENSING AND SWITCHING SYSTEM

Before Sonac, sensing and switching control systems which involved breaking a beam of energy were limited by vibration, dust, smoke, steam, air contamination and too much or too little light. Sonac's ultrasonic energy "beam" is completely free of these limitations. The acoustic lens on Sonac sensors can actually be painted without affecting performance. Utilizing high frequency sound also means there are no lamps to burn out. Savings in replacement parts and maintenance time often means Sonac pays for itself. Sonac is completely transistorized, providing you with a rugged, dependable electronic circuit.

These are just a few of Sonac's many uses. Optional equipment includes reflectors for precision beam and positioning control, and coupler assemblies for use with flexible tubing for remote sensor locations. This descriptive booklet will be sent to you on request.



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Circle 728 on Page 35

AUTOMATION abstracts

THE IMPORTANCE OF KNOWING

By W. G. ALEXANDER
President
Ryan Transdata Inc.
San Diego, Calif.

DATA is used primarily for the transmission of intelligence from one place or person to another. In the majority of situations, the data is used to aid in the process of decision making; or, as a record for storage and future reference. This process of making timely intelligent decisions has presented a challenge throughout history and the task is growing more difficult as our society and the data describing it become more complex.

The storage and retrieval of data is one of the major problem areas faced by anyone contemplating work in the information handling field. Classification and indexing is a very formidable problem and one which must be properly solved if we are to be able to go back into our files and retrieve the significant data we desire. There is no surer way of losing data than to insert it in a file without proper indexing and cross-referencing. We must also have the proper classification if we are to pull out the specific data required for a certain decision without exposing the requestor to a large mass of related data which would tend to confuse rather than clarify the situation. A detailed look at almost any business, government agency, or scientific center will reveal many concrete examples showing this need for improved methods of making vital data available.

Anytime anyone suggests putting an information handling or paperwork automation system into a company or government office, he immediately hits the block of the guardians of the capital investment bankbook, because it does cost money to study the problems and to install the equipment and to conduct the trial run. All of these steps must precede the reaping of the benefits of the system.

After reviewing these roadblocks, many people ask why I am foolish enough to expect this business to grow . . . the fact is that the cost of not knowing is even higher than the cost of putting a system in that would let us know. In the U. S. alone, we pay $1 billion a year for outright duplication of R&D effort in doing over again the things that have already been accomplished.

Up to $6 billion a year of R&D effort is misdirected because of a lack of knowledge of previous work. In other words, doing things differently from the way in which they would have been done had the scientists and engineers been fully aware of prior work in this field.

If the scientist and engineer could start with a full knowledge of the current state-of-the-art, we would in effect add up to $7 billion per year of vital research and development to the U. S. fund of knowledge, without spending one extra cent.

Business Aspects

The average business can realize equally satisfying financial results from the use of advanced information retrieval, data entry, and presentation techniques. There are 3 million firms in the United States. Of these firms, 2.94 million employ less than 100 people. These small firms often play an important role in the economy of their home community. Any community which can offer an environment which will

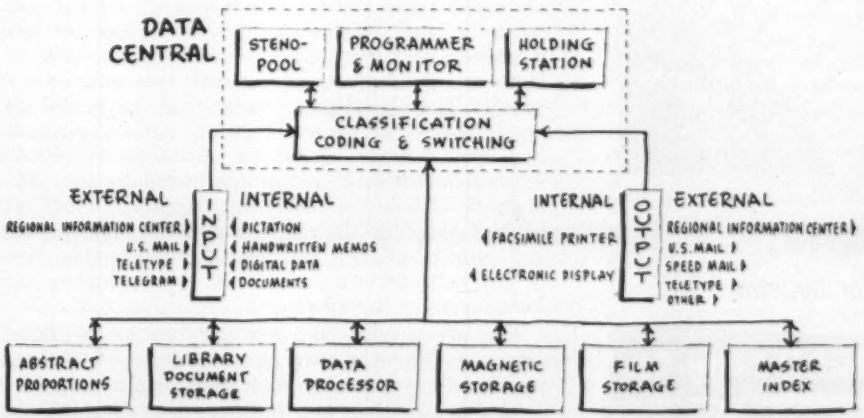
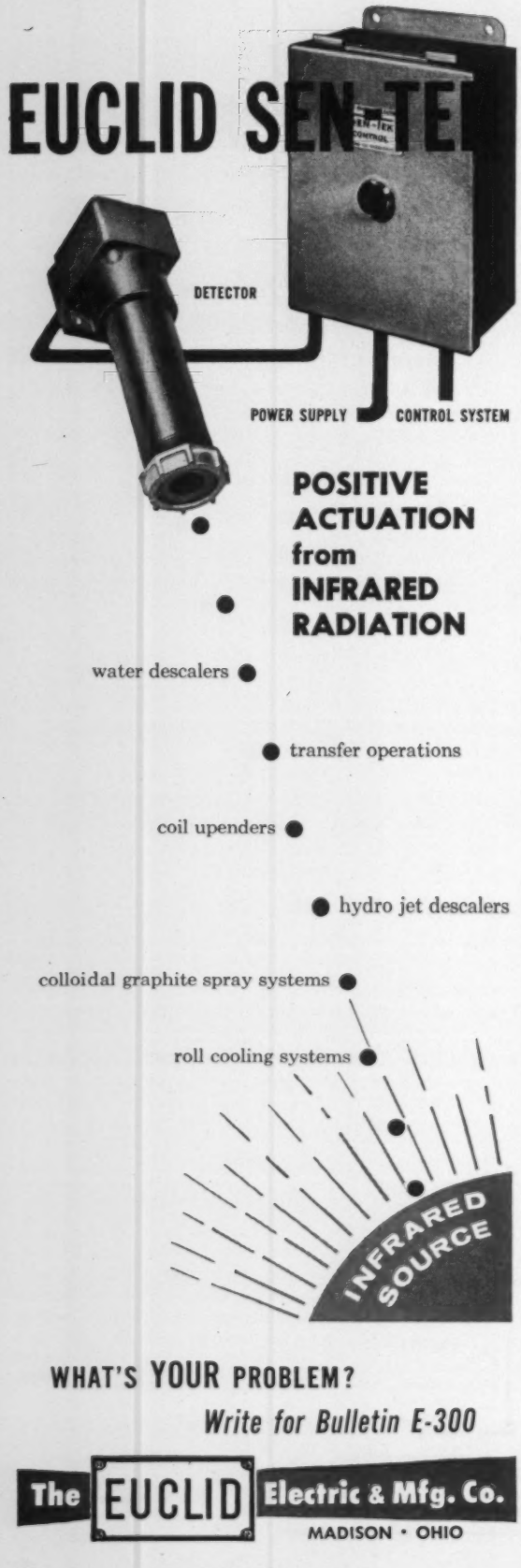


Fig. 1—Diagram of typical business data retrieval system illustrates various factors which must be co-ordinated if centralized system is desired.



make these small companies more competitive will find itself in a position to attract them. A well planned and properly supported information center is one ideal way to do this. Let me cite one specific example: The U. S. Government issues many reports, bulletins and statistics which when properly digested and related to a specific business constitutes a powerful planning tool. The small business simply cannot afford to hire the staff to digest this data, nor can the management afford the time to do this. Therefore, the small business is denied the full benefits of this type of service. Most large companies do have a staff to handle this data and find it a very valuable tool in their operations. A regional information center might perform the reduction of this data and the consolidation of the data into a form most useful to the majority of the small businessmen in its area as a very useful and worthwhile contribution.

Before an effective regional information center can be established, many basic questions must be answered. Some of them are: 1. Will we start along conventional lines and grow into a more sophisticated system? 2. We must eventually have a multidiscipline system. However, would it be easier to start a pilot, monodiscipline unit? 3. If machine retrieval—when? 4. Can conventional library methods provide necessary index density? 5. Should this be handled separately, or as a part of the public library? Are the two compatible? 6. Just what kind of center are we looking for: Public; private, closed or open use? 7. Who will be the users? 8. Who will contribute material? 9. Who pays the bill?

Typical System

A diagram of a typical business data retrieval system illustrates the techniques and complexity involved, *Fig.* 1. External data is received through conventional methods in use today, plus new techniques of speedmail, a proposed new postal service which offers same day delivery of mail anywhere in the U. S. and industrial facsimile which is used to transmit written data, charts, photos, etc. Internal data is entered through typewritten copy, handwritten memo, dictation and digital data entry devices. These digital data entry devices are used to enter bookkeeping, timekeeping, inventory and similar data automatically in a digital language. The data all flows through the classification station where it is properly indexed and coded for future operations. Internally generated data is given a first order classification by the originator. However, the majority of external data will be uncoded. The classification center must be staffed by highly competent personnel since system effectiveness is a direct function of the ease and accuracy of data retrieval and this is in turn controlled by the thoroughness of indexing and cross-referencing. Handling of the data within the central may be on random basis and each bit of data may pass through one or more of the indicated stations. I will briefly explain the function of each station.

The stenographic pool converts dictation to digital data, sorts incoming mail, inserts multipage documents into handling containers and other similar tasks.

The programmer and monitor unit schedules the

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computer to prepare routine reports, such as work status, machine efficiency, spare parts lists, material shortage list, schedules, profit and loss statements, etc., runs purging programs through the files to remove obsolete material, review purged data prior to dump, and monitors over-all system performance.

The holding station is used to hold forced data (data which is automatically presented to a station without that station requesting it) until the addressee acknowledges receipt of data. In the case of priority messages, the sender is notified automatically if this message is not delivered in a pre-established time.

The abstract preparation unit will ultimately be completely mechanized; however, until approximately 1965 this will be a manual operation. The object is to prepare brief abstracts of multipage documents. The abstract is then stored in magnetic tore and the complete document goes to library document storage.

Library document storage contains three classes of documents: reference works, technical reports and catalogues. The reference works are retained permanently, the technical reports are retained for a fixed period of time, then reviewed and if deemed to have continuing value, they are microfilmed and the original destroyed. If they have no further value, they are destroyed and the abstract is microfilmed and sent to historical section of the film file. Catalogues are automatically destroyed at the end of the fourth year on the assumption that a more recent edition is available.

The data processor is a standard digital computer selected to handle the computation load of the company, plus the preparation of special management control data and servicing of the storage and index units. The magnetic storage is in two forms—one is a video file using conventional video tape for storage of facsimile and digital data—the other is a very large capacity rapid access digital data store, used for accumulation of data during processing steps and for servicing of printout and display equipment.

All permanent data is retained in the magnetic store for an initial period, usually one month. At the end of this time, it is transferred to the film storage for long term storage. Transient data such as current position of work in progress is dumped at the end of its use period.

The film storage unit records data on aperture cards (punched cards containing a frame of microfilm) for long term storage. When retrieved for use, the cards are scanned by facsimile equipment and the card itself never leaves the file area.

The master index is a large capacity random access magnetic store and logic unit. All data available to the output system is cross-indexed in this file and upon a specific request a list of the documents most likely to supply the information desired is presented on the requestor's display; he then enters requests for any of the documents he desires from the lists.

The output unit supplies external output in the forms of letters, telegrams and facsimile messages. Internal outputs are in the forms of desk or wall displays and hard copy facsimile printers. Data sanctity and privacy is controlled through authority codes which will only accept requests for sensitive data from stations authorized to receive it.

The system outlined is within the state-of-the-art to-

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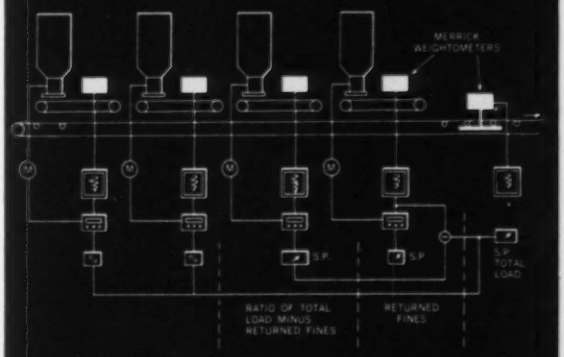

Loading is made at the set-point station, which imposes an output voltage signal to all ingredient control stations. All materials are controlled to a percent of the total load required. Recoverable material set-point is determined by returned product available. Feed is controlled by difference of returned material and total load of master set-point.

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day. The problem facing any company such as mine in trying to sell such a system is that it is difficult to prove the potential savings in terms acceptable to a controller. The cost however, must be stated in cold, hard terms, and as you can gather from the equipment involved, the first cost is high. This condition will slow down with growth, but will not stop.

In 1950, the computer industry was simply a novelty —today it's a giant—by 1975, the computer industry will merely be a segment of the broader information systems business. Transmission of data over communications lines will exceed their use for conversation.

From a talk entitled "Data Handling—An Aid to More Effective Management" presented before San Diego Chapter Armed Forces Communication Electronics Association, San Diego, November 1960.

COMPRESSION MOLDING COST FACTORS

By ROY WILSON
F. J. Stokes Co. of Canada Ltd.
Toronto, Ontario

THERE are six factors that determine the production cost of a plastics part: 1. Part design. 2. Volume. 3. Mold. 4. Equipment. 5. Cycle. 6. Efficiency. *Part design* is by far the most important factor. The skill of the designer fixes the material and equipment to be used, the cavity cost and cycle time, and to some degree the efficiency of the molding operation. For instance, the material used for the part depends on its function, impact resistance, dielectric strength, beauty, shrinkage factor, or structural strength. The shape and cross-section of the part is determined by its function. These in turn affect the cycle time and dictate the molding method, whether it be compression or transfer molded.

Coring plays an important role in part design. This is used primarily to reduce the material cost and cure time. However, long, thin cores mean mold pin breakage, or more expensive mold cost, or the higher equipment and operating cost of transfer molding. A length to diameter ratio of core pins should be no more than 2.5:1 for automatic compression molding.

Molded-in inserts indicate a semiautomatic operation. If the volume is high, an automatic insert loader reduces the labor cost, but increases the equipment cost. Inserts can be fastened automatically in a separate operation after molding. Side-cores and threads also mean higher equipment cost. However, they can be run automatically, even on small presses. Side cores can be molded into the part without using side-draw attachments. This is done by overlapping of opposing pins in force and cavity to make the shape of the hole.

Volume is not so important for automatic molding as it is for semiautomatic operation. The original, short-run of the part can be set up on automatic operation to provide minimum press and tool investment for the best machine utilization. Two or more parts may be needed to provide enough molding time for about six months of the year. As the volume of the part increases, additional units of mold and press may

be added. The extra capital investment is justified in the same way the original short-run was justified. With four complete units molding, a breakdown in one unit means only a 25 per cent loss in production.

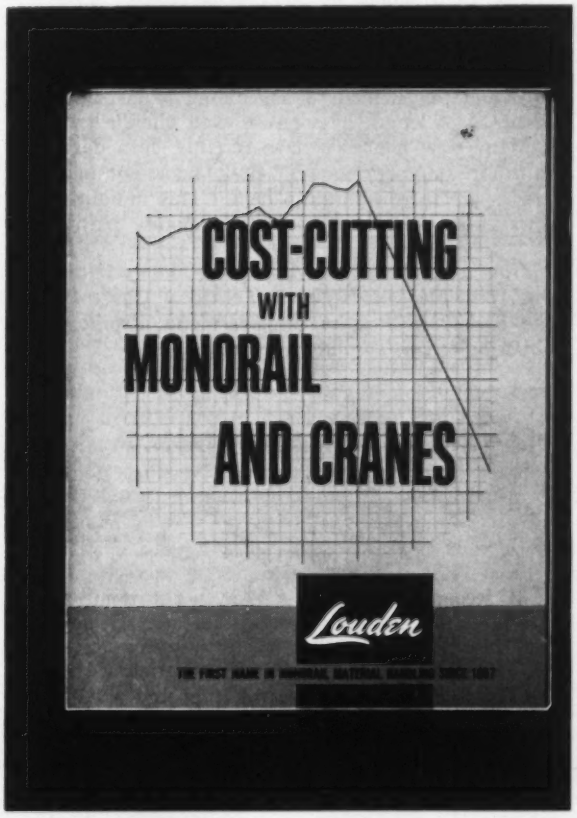
The floor space required for two complete units is less than that of a larger press running semiautomatically, and the investment and operating costs are greatly reduced. The flexibility of multiple units allows the molder to break into molding runs without completely disrupting production.

Mold cost is very dependent on part design, which determines the details, finish, configuration, and equipment used. A common fallacy of many molders is to attempt to save a few hundred or even a thousand dollars on their mold by taking the lowest tool quotation. There are many qualities built into a mold that are not evident to the naked or untrained eye. Qualities such as finish and accuracy reduce the setup time and the run-in time to provide the high efficiency that fully automatic molding operation needs. The best automatic press in the world will not produce quality parts efficiently from a cheap mold. To produce quality, you must purchase quality.

Equipment for automatic molding has developed to the point that demands a sharp reappraisal of many existing plastics parts. New applications of old, automatic press principles have led to the fully automatic transfer molding press, 50 to 200 tons capacity. In such presses a vibratory-type bowl feeder moves the preforms down a track where the correct number of preforms are counted and then transferred into a shot holder, which in turn retracts into the preheater for a timed interval. At press opening, the complete runner, cull, and part system is ejected positively from the press, and the preheated shot is transferred to the plunger or transfer pot of the press (bottom transfer), and the press closes. While the cure is taking place, the shot holder is being loaded for the next cycle. A simple fixture, outside the press, can automatically degate the parts if the size of run justifies.

A small press, specifically designed for short-run automatic transfer molding of small parts, boasts a 25-ton clamp and 5½-ton transfer ram, using cold powder. It is also used for automatic compression or semiautomatic insert-molded parts.

Another new press of 150-ton capacity is designed for insert-molded parts. It has three tie-rods, with two bottom mold halves rotating 180 degrees about one of them. The top half of the mold remains fixed to the top, moving platen. When the top mold half is engaged with one bottom half in the press, the other bottom half is ejecting parts and runner at the operator's station. He clears the mold and loads the inserts and preforms for the next cycle, which continues after he presses the reset button, and after the parts in the first half have cured. The press opens, just far enough to clear the guide pins of the mold, and rotates 180 degrees to the operator. At the same time, the second half rotates into position to engage the top half of the mold. Two presses can be arranged to face each other to use a common indexing table with two operators. An automatic insert loader is then



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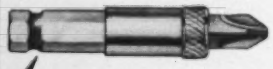

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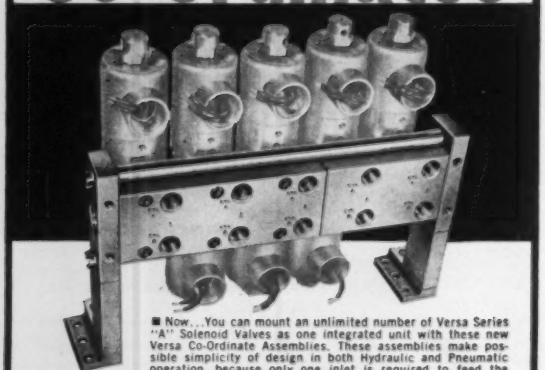

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practical, if the volume is high enough.

Cycle time depends mostly on cure time, which is about 90 per cent of the molding cycle. The part designer tries to minimize this. Control features such as low-pressure close, mold breathe, double-shot and flash thickness control switches, have added seconds onto the dry cycle of automatic presses. To compensate for this, press manufacturers added adjustable daylight and the regenerative circuit (fast approach) to reduce the dry cycle time once more.

The greatest reduction in cycle time has come with the integral preheater for powder, which mounts right onto the standard feeding board. Material is agitated for exposure under a variable heat source, prior to its entry into the feed tubes. Cure reductions as high as 30 per cent have been experienced. Material suppliers brought out fast-setting resins to further reduce cycle time.

To speed-up changeover time, the quick-change feed assembly was introduced. The feed assembly is set up while the mold is heating up. The amount of feed is preset from the end of the previous molding run. The molder can start producing parts as soon as the mold heat is up.

Efficiency of the automatic molding operation depends on the press, the mold, and the material. The press must be capable of cycling by itself, unattended, 24 hours a day, with raw material being supplied to the hopper, and ejected parts collected. The ejection mechanism should be positive to maintain control over the molded parts to prevent them from accidentally falling back into the mold, and to remove all traces of flash after each cycle.

The mold should be polished to produce good finishes and prevent flash from sticking to the mold faces. The mold design should reflect the minimum of complications of the part design. The quality of steels used and the methods of machining molds should be discussed at length by someone well qualified.

Many new materials have recently been developed to run in automatic presses. Bulk factors and plasticity grades are more uniformly held. This uniformity allows closer tolerances and better quality parts.

From a paper entitled "Automatic Compression Molding" presented at Regional Technical Conference of the Society of Plastics Engineers Inc., sponsored by Ontario Section, Toronto, November, 1960.

PLANNING FOR MAINTENANCE

By O. C. GOCHENOUR
General Foreman, Maintenance
Aliquippa Works
Jones & Laughlin Steel Co.
Aliquippa, Pa.

THE recent installation of a 44-in. hot strip mill at J&L Steel Corp., Aliquippa Works, included a program-control reversing rougher. This reversing rougher is automatically operated by a card-programmed control system wherein punched cards, prepared and stacked in a card reader, contain the required information for rolling each slab in the schedule. Each card contains all the information for a given schedule for as many as nine passes to control mill screwdown opening, edger

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width adjustment opening, mill speed, and edger speed compensation for mill draft. The information from the card is transferred by the card reader to the transistor-type memory storage section of the program control. Hot metal detectors are used to determine slab position and "step" the control automatically for each pass.

Our maintenance organization began to plan, before construction started, the maintenance of this, the first control equipment of its kind to be installed in our plant. In a situation of this kind, it is obvious that to realize the increased efficiencies in scheduling, heating practice, and product uniformity afforded by automatic program control, prolonged manual operation cannot be permitted. The net result is a demand for rapid repairs which ill affords the opportunity to depend on outside personnel to make such repairs. Since maintenance problems of this type of equipment can be expected to vary in nature and occur with lower frequency, maintenance personnel must have ability commensurate with the task of keeping the equipment operational. A thorough understanding of circuit functions is necessary to locate troubles when they occur because of the multiplicity of circuits and graduation from the more simple repetitive maintenance requirements of basic electrical equipment.

Although one might elect to employ a specialist for this program control because of its importance for the successful operation of the total installation, this choice is deemed less desirable than employing skilled motor inspectors with the additional training necessary to maintain this equipment along with all other electrical equipment in his area.

The technical specialist for maintenance of new types of control is regarded as unnecessarily costly and disadvantageous because it discourages or prevents the motor inspector from learning how to maintain this more modern equipment. Furthermore, since the use of program control can be expected to increase with time, we should accept the responsibility for aiding our personnel to grow in knowledge with its usage.

The solution of the problem at hand begins with the selection of employees whose duties will include the maintenance of this relatively complex equipment. In our case, where a complete equipment was constructed and no contractual limitations prevented the transferring of employees into the new department, the problem was somewhat simplified.

Objectives must be congealed before the selection procedure is started so that fundamental requirements are not overlooked for initial starting and continued successful operation during the years that follow. Certainly these objectives may be added to or changed for different operations but those believed to be basic are:

1. That the supervisors shall have a background to permit them to comprehend the equipment operation.
2. That they shall be able to teach their crews to understand and repair subject equipment.
3. That they shall be well rounded to handle the essential administrative duties of the supervisor.
4. Similarly, that non-supervisory employees shall have a suitable background of experience and ability to train helpers and to maintain conventional types of electrical mill equipments.

The objectives seek to provide maximum efficiency and the assurance that more than one or two specific

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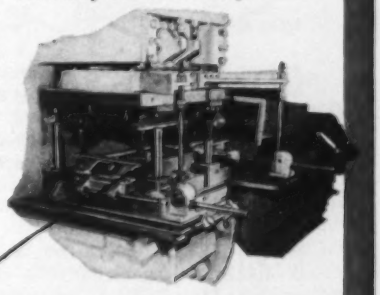

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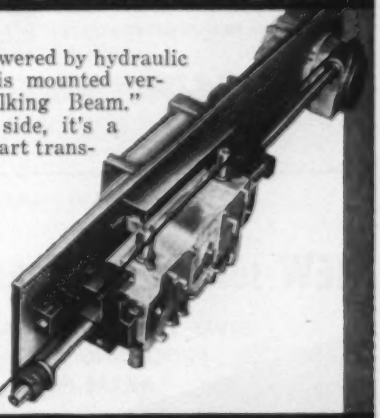

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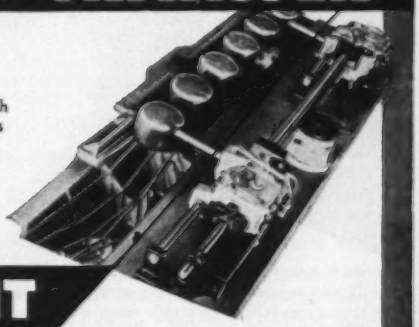

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individuals will have the necessary understanding and ability to promptly repair or test all electrical equipment in the area whenever the need arises.

Since apprenticeship training is not ordinarily made available for assigned maintenance personnel, the question may arise in the reader's mind, from where do these qualified persons come and where do they receive their training? In our era, there are the military trained in electronics who have been working in industry, amateur radio operators, as well as those who have studied related formal courses in our colleges or in the correspondence and trade schools. In some instances, motor inspection helpers with four years or more on the job experience may qualify.

With the basic knowledge derived from one or more of these several sources and practical experience in steel mill control, the training of employees in the static machine control is but one step away and training time is relatively short.

It is our choice to first train the supervisors who in time will teach their employees. During the construction period, the Training Supervisor from the Works Training Department prepares a manual for those supervisors to be trained that includes basic information encompassing the equipment and duties of personnel, mill operation, and other pertinent information.

The control manufacturer, recognizing the need for instruction in operation and maintenance of new equipment, aids in supplying information, circuits, and diagrams for the manual and conducts the training necessary for understanding the equipment. Basic circuits and concepts are explained in an informal class allowing for questions when they arise. Block diagrams of the new equipment aid in understanding the total concept, and wiring diagrams are explained to enable the student to use this important tool.

During the training period the class moves to the installation site to work on the equipment and to correlate the classroom training with it. Much is to be learned at the initial test, check out, and trial run of the equipment and the supervisors are encouraged to follow this phase as closely as possible.

On a routine basis, each of the four motor inspectors in the hot strip mill carries on his work in one of four areas: Motor room; coilers; finishing mill; and reversing mill and furnace area. In case of trouble all may work in the same area to carry on the repair. The helpers are routinely assigned to assist in the repair of motors, bearings, lights, and limit switches in addition to necessary work on spares.

The training program's effectiveness can be measured by the delay time during the first year of operation, and the number of calls for outside help. It is pleasing to relate that the result of our training produced a self-sufficiency with extremely low delay time.

The experience gained from three years of operation convinces the writer that static program control of steel mill equipment has justified itself and that maintenance of this equipment poses no great problems when planned for in the manner described.

From a paper entitled "Planning Maintenance for Automatic and Static Machine Control" presented at the 12th Plant Maintenance & Engineering Show, Chicago, January 1961.

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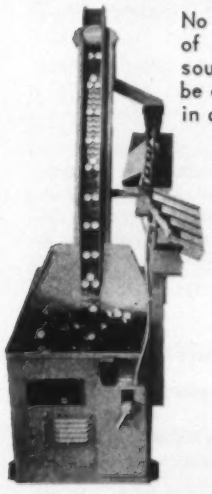

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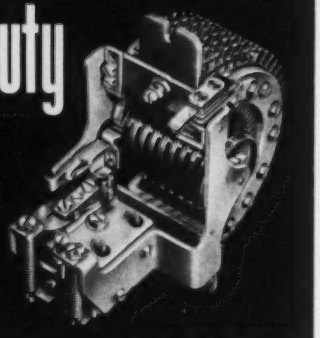

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new books

CENTRIFUGAL PUMPS: SELECTION, OPERATION, AND MAINTENANCE

By Igor J. Karassik, manager of planning, Harrison Div., Worthington Corp. and Roy Carter, 496 pages, 7⅛ by 10 inches, published by F. W. Dodge Corp., New York; available from AUTOMATION; *$15.75 postpaid.*

The purpose of the authors is to guide the centrifugal pump user in system design and equipment selection for the most satisfactory combination of the two. Carrying forward this practical theme, the authors also discuss aspects of obtaining maximum service from installed equipment. Controls and pump drivers are subjects of separate chapters.

GUIDE TO U. S. GOVERNMENT STATISTICS

By John L. Andriot; 402 pages, 8½ by 11 inches; published by Documents Index, Box 453, Arlington 10, Va.; $15.00 (10 per cent discount for cash orders).

The third edition of this bibliographical guide to governmental statistical data covers over 2000 items, including the recurring publications, the statistical series, and important one-time publications of statistical value. Data from various departments, independent agencies, the Executive Office of the President, and the judicial and legislative branches of the government are listed.

THYRATRONS

By C. M. Swenne; 83 pages, 5¾ by 8¼ inches, illustrated, published by Macmillan Co., New York; available from AUTOMATION; *$3.00 postpaid.*

This is an introduction to the physical principles, electrical characteristics, basic circuits, and applications of thyratrons. It is intended to bring an appreciation of thyratrons and their use to engineers seeking more familiarity with electronics. Technical data on current thyratron types are appended.

THE NEW SCIENCE OF MANAGEMENT DECISION

By Herbert A. Simon, professor of administration, Graduate School of Industrial Administration, Carnegie Institute of Technology; 50 pages, 5½ by 8¼ inches, published by Harper & Brothers Publishers, New York; available from AUTOMATION; *$2.50 postpaid.*

The author's work has been expanded from three lectures given as Ford Distinguished Visiting Professor before the School of Commerce, Accounts, and Finance of New York University. He believes that modern technology and understanding have paved the way for a revolution in decision

making, or managing. In a very readable manner he highlights the reasons why he believes that the "thought process" itself can now be understood, and what this implies for industry.

MANAGEMENT GUIDE FOR PRODUCTION CONTROL

By B. T. Lewis, manager, Industrial Engineering Branch, Area Public Works Office, New York, Dept. of the Navy and W. W. Pearson, assistant director, The Management Institute, Div. of General Education, New York University; 72 pages, 5½ by 8½ inches, soft cover, published by John F. Rider Publisher Inc., New York; available from AUTOMATION; *$1.40 postpaid.*

It is not the intent of this book to present a new system of production control. The authors have undertaken to provide a pattern to follow in the application of proved methods of control. Included in the material highlighted are applications of mathematical techniques and electronic data processing and punched card systems to both production and inventory control.

INFORMATION RETRIEVAL AND MACHINE TRANSLATION VOL. 3, PART 1

Edited by Allen Kent, associate director, Center for Documentation and Communication Research, School of Library Science, Western Reserve University; 686 pages, 6 by 9 inches, published by Interscience Publishers Inc., New York; available from AUTOMATION; *$23.00 postpaid.*

This first part of a proposed two part volume records the papers and discussions of the International Conference for Standards on a Common Language for Machine Searching and Translation. Approximately 200 pages of this book are devoted to a review of the literature on machine searching research, development, and operations, and on machine translation research and development.

Government Publications

Impact of Automation. *Bulletin No. 1287, by U. S. Dept. of Labor, 114 pages; available from Supt. of Documents, U. S. Government Printing Office, Washington 25, D. C.; 60 cents.*

Publication presents 20 articles, from the Monthly Labor Review, that were based on studies, reports, and speeches. They describe various labor aspects of automation and technological change and include some examples of specific effects on collective bargaining relationships as well as summarizing case studies.

Precision Measurement and Calibration. *National Bureau of Standards Handbook 77, three volumes: Vol. 1, Electricity and Electronics, 845 pages, $6.00; Vol. 2, Heat and Mechanics, 965 pages, $6.75; Vol. 3, Optics, Metrology, and Radiation, 1,025 pages, $7.00; available from Supt. of Documents, U. S. Government Printing Office, Washington 25, D. C.*

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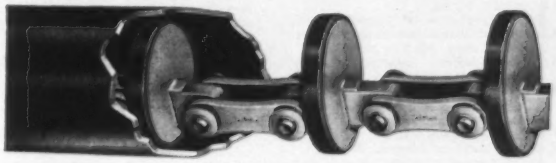

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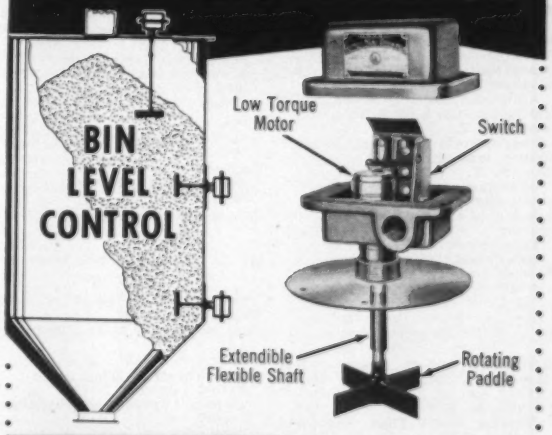

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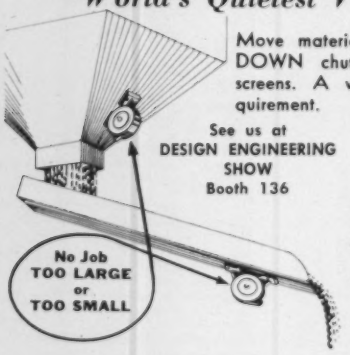

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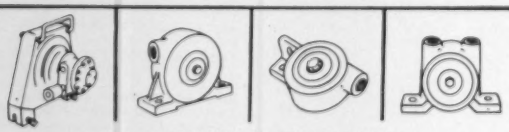

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Circle 748 on Page 35

are you stuck?

confidential file

Readers with problems concerning systems, equipment, or components for automated operations are invited to outline them to: The Editor, AUTOMATION, Penton Bldg., Cleveland 13, Ohio. Readers having solution suggestions are invited to submit them and should refer to case number and title of the problem involved. Dates shown with suggestions indicate issue in which the problem was presented.

CASE 2296-P

ALIGNING AND STACKING PIECES

. . . We are investigating a process in which 600 pieces per minute are discharged from compression molding machines. Each piece is 7-11/16 by 1⅝ by ¼ inch and is symmetrical except for the shortest dimension. We would like to align and stack these pieces neatly in boxes, preferably in piles of 100. We feel certain that there is machinery on the market which can perform this job for us and are asking your assistance in locating manufacturers of such equipment . . .

Process Engineer

CASE 2297-P

FORMING AND WELDING CHAIN

. . . We would appreciate your assistance in obtaining information on the forming and welding of side welded chain. We manufacture all types of automatic welders. These machines are produced for use in our plant and for other manufacturers. We wish to design a chain welder but have been unable to find any literature or specifications on welders for this purpose. Your help in securing this information will be appreciated. . .

President

CASE 2298-P

STRIPPING INSULATION

. . . I have not been able to find a device that will automatically strip the insulation from 33 AWG wire (spiral wound, 40 ±5 turns per inch) that is wound on a 3-ply fortisan (6.5 Z turns per inch). The wall thickness of the insulation is 0.020, and the finished OD is 0.074 ±0.002 inch. Our present method is to heat the insulation and pull it off while hot. Mechanical strippers that we have tried tend to cut the wire and fortisan. . .

Assistant Plant Manager

CASE 2301-P

FOLDING AND BOXING UNDERGARMENTS

. . . We are interested in locating a company with experience in automatic folding and boxing of nylon tricot lingerie, sleepwear, and foundation garments such as slips, panties, gowns, pajamas, pettiskirts, etc. If we cannot find a company with experience, we are interested in a machinery manufacturer who can design and develop suitable equipment to fold and box these garments . . .

Chief Industrial Engineer

CASE 2302-P

TYING KNOTS AUTOMATICALLY

. . . I am interested in an automatic device that makes a knot which does not open in a soft yarn approximately 1/16 inch in diameter. The yarn is held fixed on both ends during the making of the knot . . .

Director of Research

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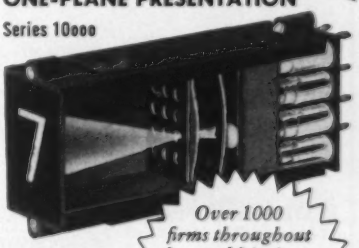

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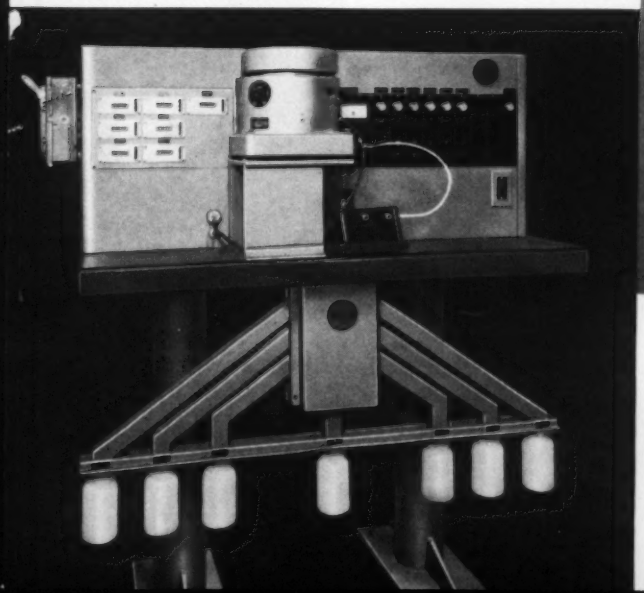

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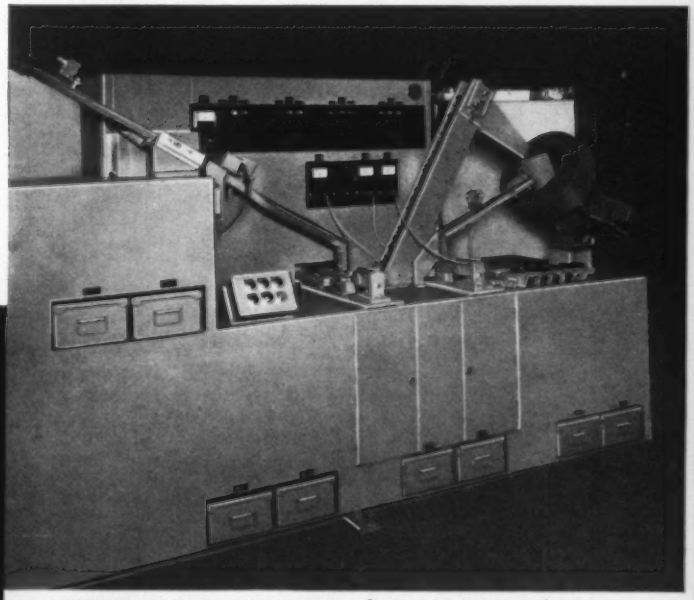

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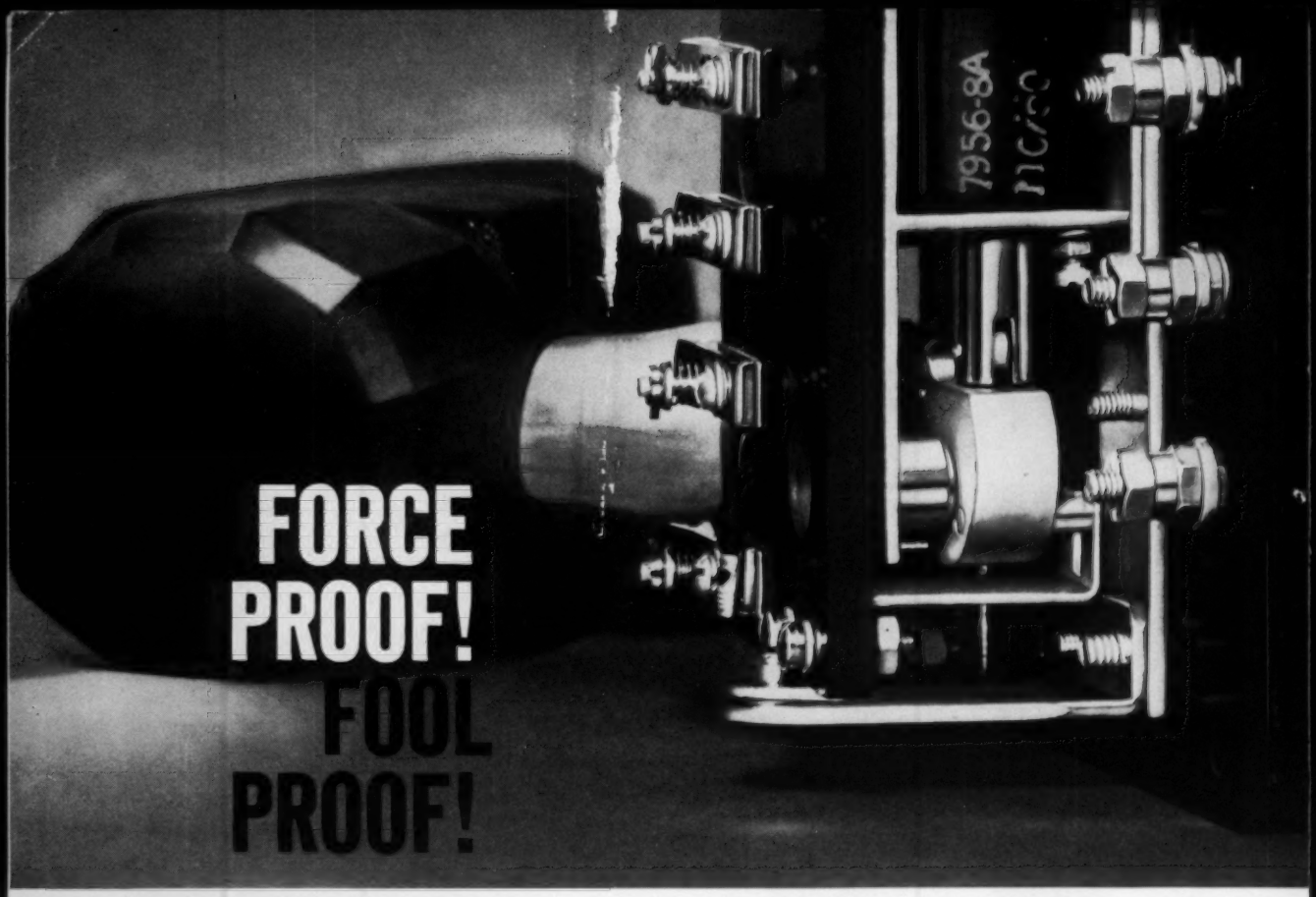

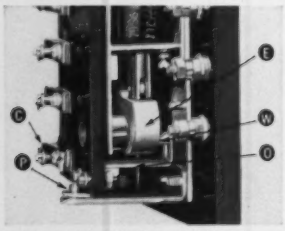

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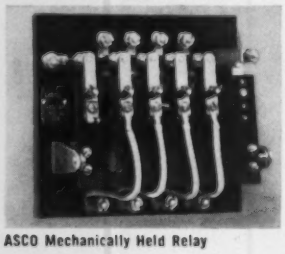

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The extensive ASCO line includes a Mechanically Held Relay to meet your requirements precisely; single pole or in combinations of 24 poles; single or double throw; 10 and 25 amperes; to 250 volts DC, 600 volts AC.

Send for Relay Catalog 57-S4, which shows you how to select the optimum relay for your specific needs.

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